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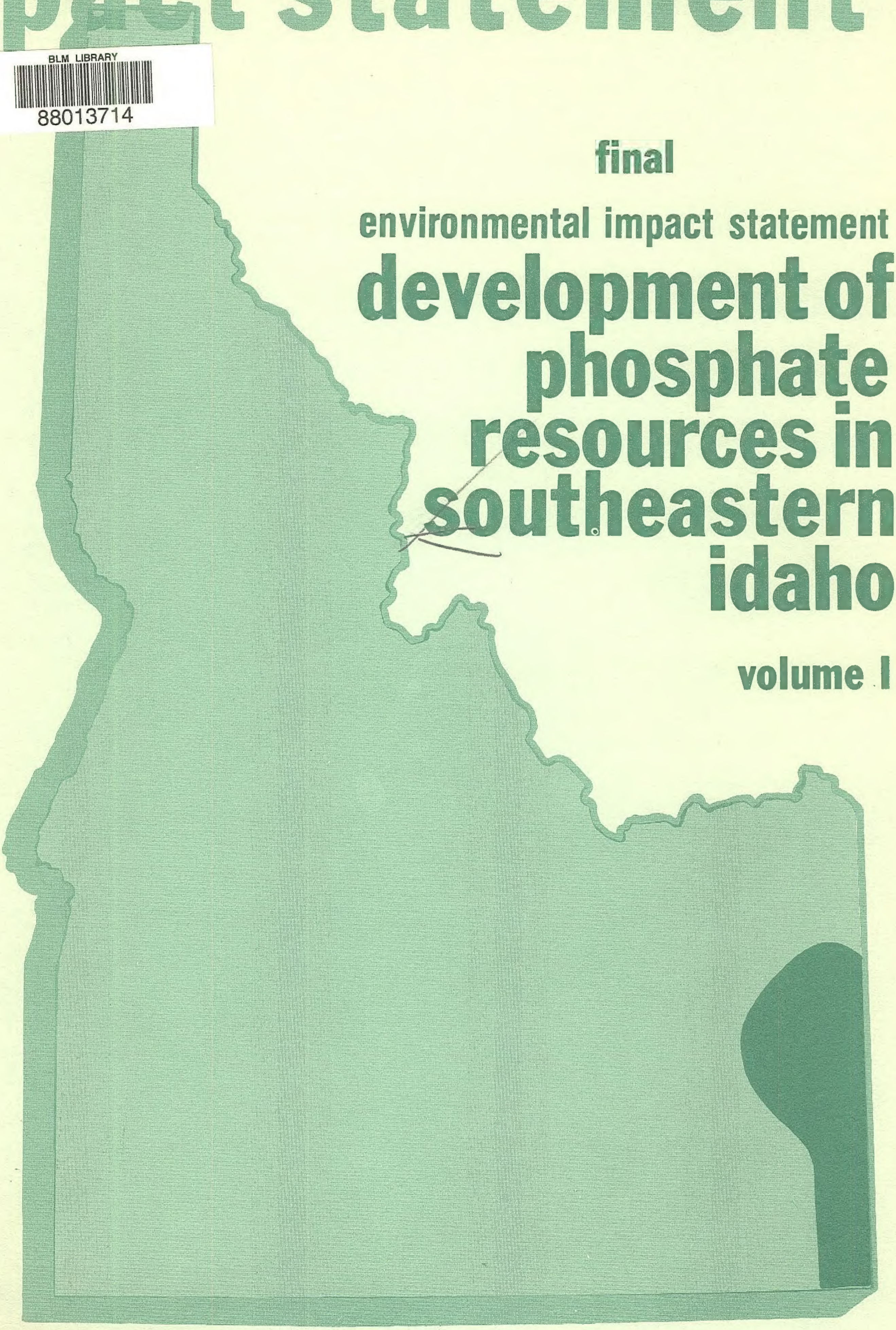

final

environmental impact statement

development of phosphate resources in southeastern idaho

volume I

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SUMMARY

( ) Draft (X) Final Environmental Statement

Department of the Interior, U.S. Geological Survey

1. Type of action: (X) Administrative ( ) Legislative

2. Brief description of action:

Approval of increases in mining and processing of phosphate ore and new applications for leases and prospecting permits. The action includes: a regional analysis covering all or parts of 6 counties in southeastern Idaho, the applications for prospecting permits and leases, major transportation requirements, and specific mining plans through the year 2000 A. D.

3. Summary of environmental impacts:

A. Land surface will be altered by pits and dumps; soils and vegetation removed from the mining and associated areas; wildlife habitat and populations reduced; and water quality lowered.
B. Ambient air quality will be lowered, particularly in the vicinity of processing plants.
C. Livestock forage will be reduced during mining operations, and productivity of the mining area will be reduced even after reclamation.
D. Population and employment in the region will increase and the socioeconomic infrastructure stressed.
E. Recreational resources will be reduced, unknown archeologic values may be destroyed, and esthetic aspects will change.

4. Alternatives considered

A. No action
B. Defer action
C. Prevent or restrict further development on existing leases
D. Approve mining with modifications
E. Approve mining as requested
F. Alternatives for Federal leasing and prospecting applications
G. Alternate sources, uses, or reduction of use of phosphate
H. Alternative processing technology and processing plant locations
I. Alternative transportation and utility corridors

5. Comments on the draft statement were requested from the agencies listed in the attached summary. Those who commented are indicated by an asterik.

6. Draft made available to CEQ and the Public;

Draft statement: April 23, 1976

Final statement:

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SUMMARY ATTACHMENT 1

Comments have been requested from the following:

Federal Agencies:

Soil Conservation Service
Federal Power Commission
*Department of Health, Education, and Welfare
Interstate Commerce Commission
Department of Transportation
*Nuclear Regulatory Commission
*Energy Research and Development Agency
*Environmental Protection Agency

Department of the Interior

*Bureau of Reclamation
*National Park Service
Mining Enforcement and Safety Administration
*Bonneville Power Administration
U.S. Fish and Wildlife Service
*Bureau of Mines
Bureau of Outdoor Recreation

State and Local Agencies:

*Idaho Department of Health and Welfare
*Idaho Department of Water Resources
*Idaho Fish and Game Department
*Idaho Department of Lands
*Idaho Department of Parks and Recreation
*Idaho Department of Agriculture
Idaho Department of Education
*Idaho Department of Employment
*Idaho Public Utilities Commission
Idaho Bureau of Mines and Geology
*Idaho Bureau of State Planning and Community Affairs
Idaho Division of Policy Planning and Coordination
*Idaho State Archeologist
*Idaho Historic Preservation Officer
Board of County Commissioners, Bannock County
Board of County Commissioners, Bear Lake County
Board of County Commissioners, Bingham County
Board of County Commissioners, Bonneville County
*Board of County Commissioners, Caribou County
Board of County Commissioners, Franklin County
Board of County Commissioners, Oneida County
Board of County Commissioners, Power County

Mayor, City of Pocatello
Mayor, City of Idaho Falls
Mayor, City of Soda Springs
Mayor, City of Montpelier
*Southeast Idaho Council of Governments
Bonneville Council of Governments
Bear Lake Regional Commission

Applicants

*Alumet Group
*Beker Industries Corporation
*Earth Sciences, Inc.
*FMC Corporation
*International Minerals and Chemical Corporation
*Monsanto Company
*J. R. Simplot Company
*Stauffer Chemical Company

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FINAL

ENVIRONMENTAL IMPACT STATEMENT

VOLUME I

DEVELOPMENT OF PHOSPHATE RESOURCES IN SOUTHEASTERN IDAHO

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PREPARED JOINTLY BY

U. S. DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY (LEAD BUREAU)

BUREAU OF LAND MANAGEMENT

AND

U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

V. E. McKelvey

DIRECTOR U.S. GEOLOGICAL SURVEY

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PREFACE:

ENVIRONMENTAL IMPACT STATEMENT
DEVELOPMENT OF PHOSPHATE RESOURCES IN SOUTHEASTERN IDAHO

This EIS presents an analysis of the broad cumulative impacts of existing and proposed phosphate-resource development in southeastern Idaho, as well as analyses of specific applications pending before the Federal Government.

At present, 83 Federal phosphate leases cover 43,370 acres in southeastern Idaho. Phosphate has been surface-mined on some of these leases and processed in the area since 1945. Five mines in the area produced about 6 million short tons (MMT) of phosphate rock in 1975; in January, 1975, annual production from these and future mines was projected at 15 MMT by 1980. The U.S. Geological Survey (USGS) supervises the operation of these mines and approves mining and reclamation plans; 8 companies holding valid leases on federally owned phosphate deposits in the area have submitted 16 such plans, 15 of which propose surface mining of outcrops of steeply dipping beds on hills and mountainsides. They cover 15,761 acres. The Bureau of Land Management (BLM) has applications pending for 3 competitive leases covering 4,280 acres, 4 preference-right leases covering 2,524 acres, 98 prospecting permits covering 121,037 acres, and 29 adjustments of terms on current phosphate leases. The BLM and the Forest Service (FS) anticipate numerous applications for land-use permits for haul roads, conveyor systems, railroads, powerlines, dumpsites, and communication-facility sites. Other related activities expected in the future but not requiring additional Federal approval include the development of powerlines; water supplies; roads, transportation, and other communication facilities; expanded residential and business communities; and augmented facilities in existing communities. Four new beneficiating plants could be constructed and the existing processing plants expanded. However, since the preparation of the draft statement, changing market conditions have resulted in reduction in expansion plans for phosphate mining and processing. Based on company estimates of production made in late 1976, to total production by 2000 A.D. would be about 15 million tons per year. The 16 mining plans that were submitted by the companies were filed to insure that if they were implemented in the future they would be covered by this EIS. In aggregate they represent a level of production that far exceeds the forecast demands for phosphate from the western field.

The BLM, FS, and USGS have determined that approval of all the pending actions would be a major Federal action likely to have significant effect on the quality of the environment. The three agencies therefore agreed to prepare this impact statement jointly in order to protect the public interest most effectively and at the same time meet their individual responsibilities under the National Environmental Policy Act of 1969. The statement considers not only the actual areas of mining and processing but also the areas directly and indirectly affected by these activities. The study area (fig. 1-1) thus includes not only the Caribou National Forest but also public lands under the control of BLM, (National Resource Lands), and the Federal mineral estate in private and State lands. The border, and southward from the Snake River to the Utah border, excluding the Cache National Forest. The area was selected partly on the basis of the anticipated levels of mining in the richer ore zones of the Phosphoria Formation and partly on the anticipated extent of social and economic effects of the mining. Although phosphate deposits extend into Wyoming and Utah, there is relatively little current mining there, nor is there strong indication of expanded mining in the near future or of likely socioeconomic impacts.

Specifically, this statement discusses the existing environment in the area and at the sites of the individual mining proposals; it identifies and evaluates the individual and cumulative primary and secondary impacts of the proposed actions at the sites and in the area; it evaluates, on the basis of existing available data, the effects of potential future mining, processing, and consumption--both within and beyond the borders of the area; and it examines in detail the specific proposed activities for which Federal action is required. It discusses the actions before the Federal Government from the present up to the year 2000, although phosphate mining in southeastern Idaho will likely continue past this date.

The 16 mining plans considered in this statement do not all propose immediate mining. Mining, rather, would be phased over several decades; its impacts, accordingly, would also be phased over the period of mining. (The 16 mining plans were submitted for approval in response to a request from the Geological Survey in October, 1974 for all possible mining activity that might occur in this century. In aggregate, they represent a level of production that far exceeds the forecast demands for phosphate rock from the western field. Total production will be dictated by actual market demands and other factors.)

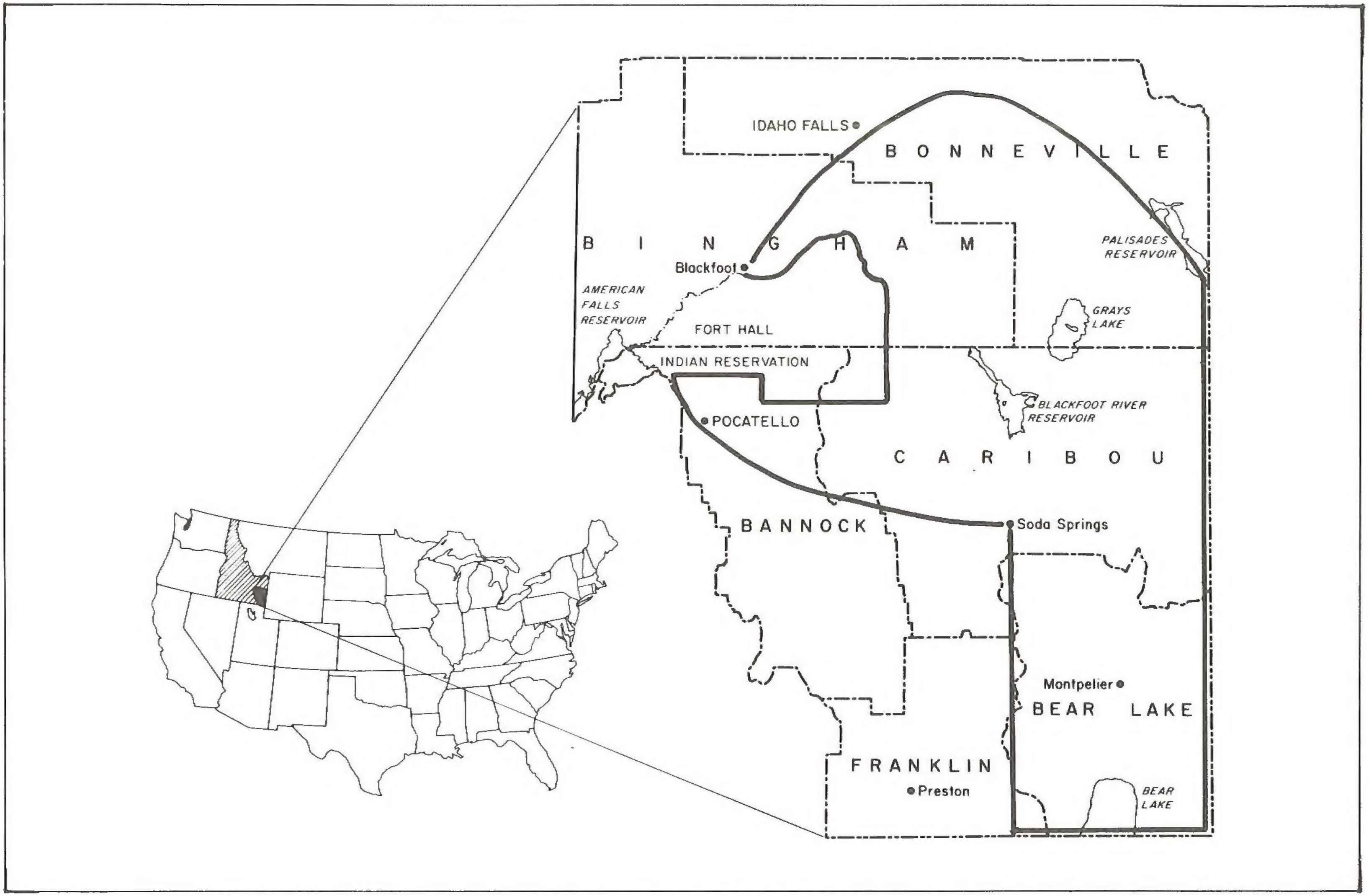

Figure 1-1.--Index map of southeastern Idaho. Heavy lines enclose general area considered in impact statement.

PART 1
REGIONAL STATEMENT

CHAPTER I
DESCRIPTION OF ACTION UNDER CONSIDERATION
INTRODUCTION

Phosphorous, along with nitrogen, potassium, and other minerals is vital to plant growth. It is also important to human nutrition. In both its elemental state and combined chemical form, it is widely used in both agriculture and industry.

The United States, U.S.S.R., Morocco, Spanish Sahara, and Australia contain and thereby control about 90 percent of the world's known phosphate deposits. Moroccan reserves are the largest and are estimated at more than 50 percent. The United States has about 14 percent of the world phosphate reserves; about 45 percent of these are in the western phosphate field.

A significant part of eastern Idaho lies in this western phosphate field. Southeastern Idaho, notably the area north, south, and east of Soda Springs, contains about 80 percent of the reserves of the western field and consequently about 35 percent of U.S. reserves. These reserves are on private and public lands reasonably accessible for mining by surface methods and are estimated at slightly over 1 billion tons using current economics and mining technology.

The western phosphate field currently supplies about 14 percent of the U.S. production of phosphate rock. Florida and North Carolina supply about 81 percent, and Tennessee supplies about 5 percent. Florida production will probably peak by 1985 and decline by 1990. Increased demands for phosphate, at about 2 percent per year over the next 20 years and the projected Florida production indicate a probable increase in production from the western phosphate field. The phosphate is used in the manufacture of fertilizer and in the production of elemental phosphorus which, in turn, is used in the chemical industry.

Involved agencies of the Federal Government have pending before them a number of actions related to the development of the phosphate resources in southeastern Idaho. The Secretaries of the Interior and Agriculture deemed the magnitude of these actions sufficiently significant, under the provisions of the National Environmental Policy Act of 1969, to require the preparation of an environmental impact statement.

This statement considers both the onsite and overall regional impacts of mining plans submitted for approval, as well as applications for competitive leases, preference-right leases, prospecting permits, fringe acreage, and readjustments of terms on existing leases. It is divided into 11 parts for convenience and clarity. Part 1 discusses the overall regional aspects of the proposed expansion of mining and processing of phosphate rock in southeastern Idaho. Part 2 discusses the applications for prospecting permits and leases that could result in future mining. Because the transportation system required to move the ore from mine to processing plant would require major expansion if all proposed mining were implemented, this aspect is discussed separately in Part 3. Finally, the 16 mining plans submitted to the Federal government for approval are discussed in Parts 4 through 11 in terms of site-specific impacts on or near the leasehold.

A. PROPOSED NEW DEVELOPMENT

1. NEW MINING OPERATIONS ON EXISTING FEDERAL LEASEHOLDS

Sixteen mining plans have been submitted to the Conservation Division, U.S. Geological Survey, in accordance with operating regulations of the U.S. Geological Survey, 30 CFR 231, and the statement in the Federal Register, Volume 39, No. 226, dated November 21, 1974. Descriptions of these mining plans are given in Parts 4 to 11. Their general locations are shown on Map 1. The 16 plans are covered by Federal phosphate leases on 15,761 acres and a Federal prospecting permit on 475 acres.

The 16 mining plans that were submitted for approval in early 1975, were used to develop the sequence of operations through the year 2000 A.D. as shown in table 1-1. The sequence is based on the mining plans provided by the companies to insure inclusion in this environmental statement. In aggregate, these total 15 million tons by 1980 and 20 million tons by 1990. This level of production was developed by the Task Force and is not intended to show the supply-and-demand relationship for the western states.

Together the 16 mining plans propose development on 15,761 acres out of a total of 43,370 acres under Federal phosphate lease. Six of these properties, if developed and operated according to current mining plans, will have phosphate rock reserves of 127 million short tons available beyond the year 2000. It is likely that other Federal phosphate resources, presently undeveloped in this area, will be exploited after the year 2000. Accordingly, impacts from mining and associated processing will continue well beyond that date.

With a continuing softening market for elemental phosphorus and phosphate fertilizer products by late 1975, actual mining could progress at lower rates than originally anticipated if the trend continues.

Indeed, testimony presented by the companies at the public hearings in September 1976 revised the production schedules so that the probable level of production was forecast to be about 15 million short tons by tons by the year 2000. Anticipated production of this rate 15 million short tons by the year 2000 is shown in Table 1-1-a. This is equivalent to an average growth rate of 3 percent. The Table 1-1 includes all newly proposed Federal lease actions as originally submitted for approval by January 1, 1975 plus ongoing operating mines located on Federal lands as of 1975. Excluded is the Gay Mine, which is on the Fort Hall Indian

TABLE 1 - 1

ANTICIPATED PRODUCTION FROM PROPOSED NEW MINES AND ON-GOING MINES [1/]

(MILLIONS SHORT TONS)

MINE	76 77 78 79	80 81 82 83 84	85 86 87 88 89 90 91 92 93 94 95 96 97 98 99	Ore Mined to AD2000	Ore Mined after AD2000	Total Ore Mined
• ALUMET (@ 2.5 MMTY):						
DIAMOND CREEK	7.5	12.5	37.5	57.5	2.5	60
SWAN LAKE GULCH				--	57	57
• BEKER (@ 4.5 MMTY):						
S. MAYBE CANYON	13			13	--	13
N. MAYBE CANYON [2/]				--	--	--
CHAMP	3.5			3.5	--	3.5
MT. FUEL		10		10	--	10
• EARTH SCI. (@ 1.5 MMTY):						
PARIS-BLOOMINGTON	3	7.5	22.5	33	14	47
• FMC (@ 2.0 MMTY): [3/]						
DRY VALLEY		8	30	38	6	44
• IMC (@ 3.0 MMTY):						
HUSKY NO. 1	6	15	30.5	51.5	--	51.5
• MONSANTO @ 1- 3 MMTY): [4/]	(1.5X)	(2X)	(3X)			
HENRY MINE [2/]	5	6		11	--	11
N. HENRY CONTINUATION		3.2		3.2	--	3.2
TRAIL CREEK			30	30	--	30
CALDWELL CANYON			12	12	--	12
BLACKFOOT BRIDGE			3	3	3	6
• SIMPLOT (@ 1-2 MMTY): [3/] [5/]	(1.5X)	(2X)				
CONDA MINE [2/] [6/]	5	5	30	40	37	77
N. TRAIL	1			1	--	1
M. SULFUR		5		5	--	5
• STAUFFER (@1.2 MMTY):						
WOOLEY VALLEY MINE [2/]	3	1.5		4.5	--	4.5
WOOLEY VALLEY NO. 3	1.8	3.2		5	--	5
RASMUSSEN RIDGE		1.2	14.8	16		16
TOTALS, EXCLUDING ONGOING MINES (SEE FOOTNOTE [2/])				282	83	365

[1/] Includes all 16 proposed Federal lease actions plus all on-going operating mines on Federal lands as of 1975. Excludes the Gay Mine on the Fort Hall Indian Reservation, with current (1975) production of 2.5 million tons. With softening market (late 1975), production estimates may be lower than originally anticipated.

[2/] Operating mines, 1975.

[3/] Excludes production from the Gay Mine, on Fort Hall Indian Reservation - FMC, 2 million tons, and Simplot, 0.5 tons (1975).

[4/] Expected production increases: 1978, 1.5 MMTY; 1981, 2 MMTY; and 1985, 3 MMTY.

[5/] Based on expansion of Conda beneficiation plant -- 1.5 MMTY by about 1978 and 2.0 MMTY in about 1980.

[6/] Private mineral rights; no Federal action required.

Table I-Ia.--Assumed production and rates, based on production of 15 million short tons per year by A.D. 2000

Company	Mine	76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99	Ore mined To 2000	 After 2000	 Total
Alumet:	Diamond Creek	0.5 ┆ 1.0 ├── 1.5 ──┤ 1.6 ┆ 1.8 ┆ 2.0 ┆ 2.2 ┆ 2.4 ├ 2.5 ┤	34.0	26.0	60.0
Beker:	Maybe Canyon[1]	├── 2.0 ──┤ 2.5 ├── 3.0 ──┤ 3.2 ┆ 3.3 ┆ 3.5 ┤	50.9	0.0	50.9
	Champ	3.7	3.5	0.0	3.5
	Mt. Fuel[2]	3.7 ┆ 4.0 ┆ 4.4 ┆ 4.7 ┤	14.9	-	-
Earth Sci.:	Paris-Bloomington	├ 1.0 ┼── 1.5 ──┤	24.0	23.0	47.0
FMC:	Dry Valley[3]	├── 2.0 ──┤	28.0	16.0	44.0
Monsanto:	Henry	├── 1.1 ──┤	11.0	0.0	11.0
	North Henry	├ 1.1 ┤	3.5	0.0	3.5
	Trail Creek	├── 1.1 ──┤	11.9	18.1	30.0
Simplot:	Conda[4]	├── 1.5 ──┤ 1.7 ├── 2.0 ──┤	36.2	40.8	77.0
	North Trail	├──┤	1.0	0.0	1.0
	Middle Sulfur	├──┤	5.0	0.0	5.0
Stauffer:	Wooley Valley[5]	├── 0.9 ──┤	9.5	0.0	9.5
	Rasmussen Ridge	├ 0.9 ┤ 1.0 ├── 1.2 ──┤	14.9	1.1	16.0
Total		5.5 5.5 5.5 5.5 6.0 6.5 7.0 8.0 8.5 9.0 11.5 11.5 11.5 11.5 11.6 12.0 12.4 12.8 13.1 13.5 13.9 14.3 14.7 15.0	246.3		

[1] Recent revision of mining plan shows increased reserves. North and South Maybe Canyon mining operations are shown combined. South Maybe Canyon mine reserves are 27.7 million tons.

[2] Total production shown exceeds estimated reserves by 4.9 million tons. Additional reserves exist in the immediate vicinity.

[3] To replace production from the Gay mine.

[4] North Trail and Middle Sulfur mines will run consecutively and concurrent with the Conda mine. The combined annual production is as shown.

[5] Wooley Valley mine units 3 and 4 are consolidated here.

Reservation, having current (1975) production of 2.5 million tons. Lanes Creek, which is proposed on private lands, is included but requires no Federal action. Simplot's Conda mine is on patented mineral lands; the Paris-Bloomington mine is essentially privately owned mineral rights. All other production as shown in table 1-1-a is scheduled from existing Federal leases, except Diamond Creek. The Diamond Creek proposal includes 650 acres under application as fringe acreage.

2. POSSIBLE MINING OPERATIONS ON NONFEDERAL LANDS

There are two mining projects that do not involve Federal phosphate leases. Alumet Group plans to mine phosphate rock from their proposed Lanes Creek mine on Rasmussen Ridge in Upper Valley, about 18 miles northeast of Soda Springs, Idaho. Mining is not scheduled to begin until after 2000. The general location of the site is shown on Map 1. The other non-Federal lease covers the Gay mine on the Fort Hall Indian Reservation about 50 miles northwest of Soda Springs. Simplot Company has operated this on-going mine since its beginning in 1946.

3. PROPOSED COMPETITIVE-LEASE SALES OF FEDERAL PHOSPHATE RIGHTS

There are three pending applications for competitive-lease sales of Federal phosphate rights on 4,280 acres. These have been filed with the Bureau of Land Management under the Mineral Leasing Act of 1920. Full descriptions of these applications are given in Part 2; their general locations are shown on Map 2.

4. PROPOSED ISSUANCE OF PREFERENCE-RIGHT LEASES

There are four pending applications for issuance of preference-right leases covering 2,524 acres. Full descriptions of these applications are given in Part 2; their general locations are shown on Map 2.

5. PENDING APPLICATIONS FOR FEDERAL PROSPECTING PERMITS

There are 98 pending applications for prospecting permits covering 121,037 acres. Full descriptions of these applications are given in Part 2; the general areas are shown on Map 2.

6. ANTICIPATED REGIONAL TRANSPORTATION NETWORK.

A major expansion of the regional transportation systems will be required to transport ore from minesites to processing plants. A greatly expanded rail system will provide most of the capability. Utility corridors will also be required to bring natural gas and electrical power to minesites and plants. Haul roads and other roads will also be required for access and transportation of commodities and personnel. Because of the significance of these transportation and utility networks, they are considered separately in Part 3.

7. ANTICIPATED MINERAL PROCESSING ACTIVITIES

Five major mineral-processing plants in southeastern Idaho presently produce phosphate or vanadium products from phosphate rock mined in the area; they include two elemental-phosphorus plants, one phosphate-rock beneficiation plant, two combined beneficiation and phosphate-fertilizer plants, and one vanadium plant. These plants are located on private lands. The Departments of the Interior and Agriculture have no regulatory authority over these plants under the Mineral Leasing Act of 1920. The plants are, however, governed by Federal and State laws and regulations, especially on air and water quality and safety. As of January, 1975 additionally, during the period 1977-81, four new beneficiation plants are anticipated--one involving washing and sizing only and three including calcining as well. These also will be on private lands. Reactivation of the beneficiation portion of the plant at Georgetown Canyon also is expected at some uncertain future date.

In addition to these new processing facilities, some long-range expansion of existing plants can be expected, although this is only speculative at this time (1975). Early expansion of the existing fertilizer and related beneficiation plants is fairly certain in the light of Beker Industries' current expansion of ore production to 5 million tons per year and J. R. Simplot's plan to double its production of concentrates at the Conda beneficiation plant by 1978.

Long-term expansion of the two existing elemental-phosphorus plants, however, is perhaps less certain owing largely to the present uncertain market, future product prices and demand, and availability of the huge blocks of electrical power required for thermal reduction of elemental phosphorus. FMC indicates it is considering plant expansion, but the extent and timing are uncertain at this time.

Monsanto Chemical Company, likewise, is presently limited by the availability of electrical power from Utah Power and Light Company. However, contingent on available power and market outlook, the company anticipates a 50-percent increase in production by 1978, a twofold increase in about 1981 or 1982, and a threefold increase in about 1985.

Although power has not been dedicated at this time for specific phosphate expansion, Utah Power and Light and Idaho Power Company indicate that their planned expansion will meet foreseeable demands of the phosphate industry in southeastern Idaho. Power will be transmitted from the south via Grace and will be available when required. If planned expansion accelerates because of favorable drastic market conditions then the timing of generating capacity becomes questionable but can be supplied in total by 1985.

Locations of proposed and existing plantsites are shown on Map 1 and in Figure 1-2. Locations of the new plant sites are based upon best available information.

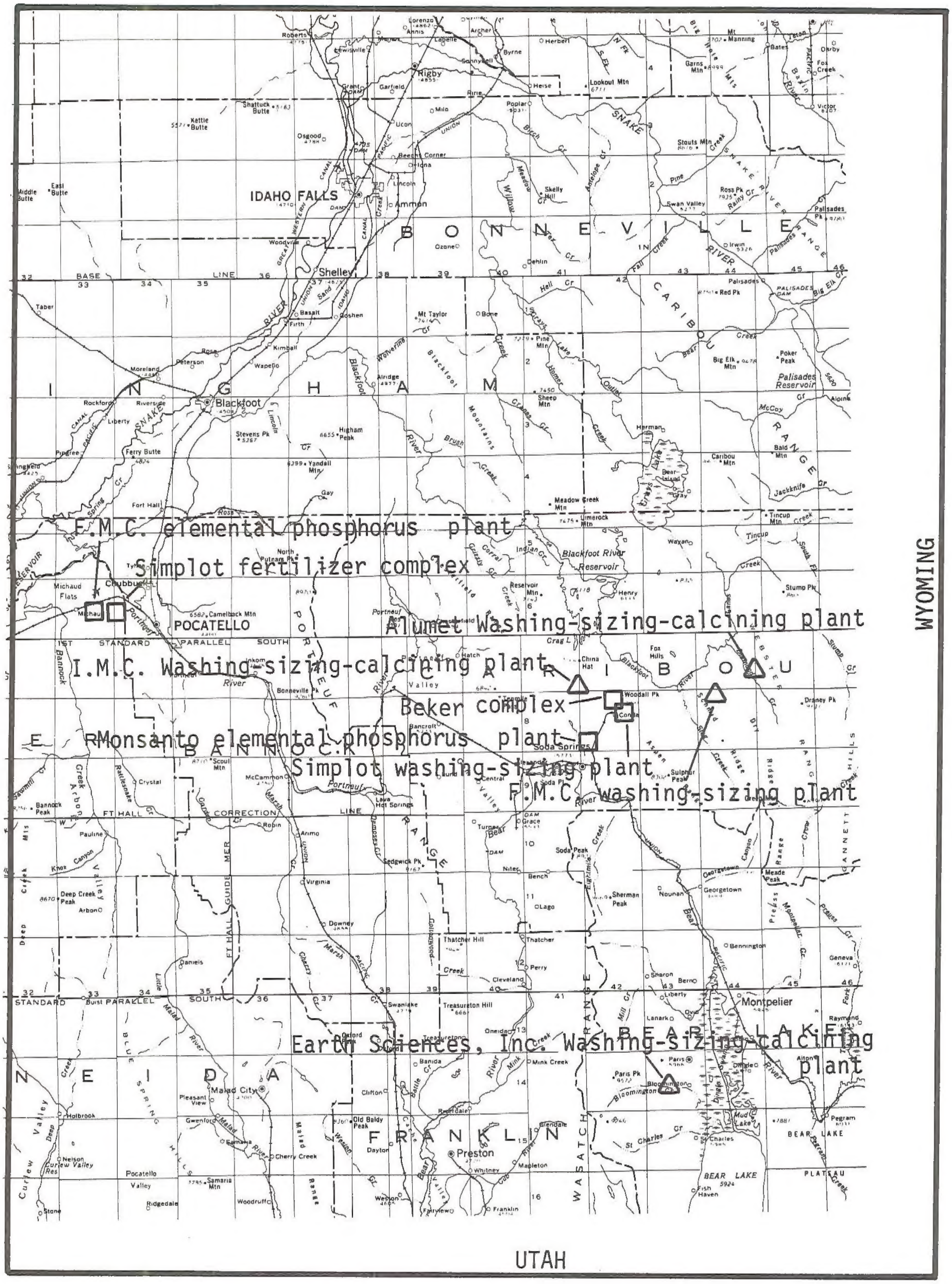
F.M.C. elemental phosphorus plant
Simplot fertilizer complex
Alumet Washing-sizing-calcining plant
I.M.C. Washing-sizing-calcining plant
Beker complex
Monsanto elemental phosphorus plant
Simplot washing-sizing plant
F.M.C. washing-sizing plant
Earth Sciences, Inc. Washing-sizing-calcining plant
WYOMING
UTAH
IDAHO FALLS
POCATELLO
BONNEVILLE
BINGHAM
CARIBOU
BANNOCK
ONEIDA
FRANKLIN
BEAR LAKE
Blackfoot
Soda Springs
Montpelier
Preston
Malad City

Figure 1-2.--Locations of processing plants: square, site of existing plant; triangle, approximate site of proposed plant.

Table 1-2.--Phosphate-processing plants and their land use requirements, southeastern Idaho, from 1975 to 1985

	Elemental-phosphorus plants			Fertilizer plants		Beneficiation plants					
	FMC	Monsanto	Beker[1]	Simplot	Beker	Simplot[2]	Beker[3]	Alumet[1,3]	Earth Sci.[1,3]	IMC[1,3]	FMC[1,2]
Location	Pocatello	Soda Springs	Georgetown Canyon	Pocatello	Conda	Conda	Conda	Diamond Creek	Bear Lake Valley	Soda Springs	Dry Valley
Year of startup	1949	1952	+1985(?)	1945	1972	1966	1972	1977	1977	1978	1978
Capacity, MMTY	2.0	1.0-2.0	0.5	1.0-2.0	3.0	1.0-2.0	4.5	2.5	1.5	3.0	2.0
Acreage:											
Total plant	155	250	48	232	250	110	160	[4] 112	55-530	1,300	110
Settling ponds	[5] 30-35	[6] 32	16	[7] 126	[8] 166	[9] 70	[10] 100	[11] 0	[12] 25-500	640	70
Waste dumps	[13] 60	[14] 20	[15] 0	0	0	0	0	0	0	0	0
Raw ore stockpile	[16] 10	[16] 16	6	4	--	[17] 7-8	16	3	1	25-40	8
Building structures	24	10	10	10	20	1	2	4	5-10	2-3	1
Other[18]	24-26	[19] 174	16	92	[20] 74	30	32	105	20-25	540-620	30

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[1] At production rate of 15 MMTY by the year 2000, the following modifications should be made: Beker, eliminate Georgetown Canyon; Alumet, startup late 1970's--capacity 1 MMTY; Earth Sciences, startup early 1980's; IMC, eliminate; FMC, eliminate.

[2] Washing and sizing only.

[3] Washing, sizing, and calcining.

[4] Dry beneficiation; no tailings ponds required.

[5] No slurry now going to ponds with use of fluid-bed dryer; only 3 acres of emergency ponds on standby. Ten old ponds totaling 30-35 acres had life of about 25 years.

Table 1-2.--Phosphate-processing plants and their land use requirements, southeastern Idaho, from 1975 to 1985--Continued

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Footnotes--Continued

[6] Includes slurry ponds and cooling water storage. Life 23 years to date.

[7] Gypsum ponds: No. 1 pond 55 acres, No. 2 pond 69 acres, and treatment pond 1.4 acres. Life 30 years to date.

[8] Gypsum ponds: Present 46 acres, new 120 acres. Life 6.8 years each.

[9] Tailings pond: One, 70 acres, operated since 1966. Life 12 to 15 years.

[10] Tailings ponds: One 40 acres and one 60 acres. Total life 8 years.

[11] Dry beneficiation; no tailings pond required.

[12] Tailings pond: 5,000 acre-feet, 10-year life. If 500 acres, 10 feet deep; if 25 acres, 200 feet deep (average) in dammed-off valley. Plan to pump dry slurry with 40- to 50-percent solids instead of about 8-percent solids. High land value and earthquake potential will govern location and decision options.

[13] Calcium silicate slag ($CaSiO_3$), 26-year accumulation. Bannock Paving Co. presently consumes about 800,000 tons per year of the 1.5 MMTY produced; it will soon utilize total slag produced at the present anticipated rate of production.

[14] Calcium silicate slag ($CaSiO_3$), 23-year accumulation. Johnson Slag Products Co. presently consumes about 160,000 tons per year of the 900,000 tons per year produced. Grossly expanded plant production rates anticipated (twofold in 1980, threefold in 1985, and fivefold by about 1992) are expected to enlarge the slag pile considerably owing to the limited local slag market.

[15] Slag used as road metal.

[16] Includes 2 acres of nodule storage.

[17] Includes concentrates storage of 0.4 million tons.

[18] Includes onsite roads, parking, railroad sidings, landscaping, staging areas, product storage piles, utilities substations, and other related support facilities.

[19] Includes 10 acres of railroad trackage, 10 acres of landscaping, sizable parking area, and coke and kiln dust piles.

[20] Includes 10 acres of railroad trackage serving the adjoining integrated beneficiation and fertilizer complex.

Land requirements for the present and projected plants are given in Table 1-2.

As of September, 1976, however, major reductions in estimated mining and processing of phosphate ore have greatly altered the planned expansion. FMC, Monsanto and Beker now plan no expansion in the foreseeable future. Simplot estimates expansion based upon normal growth rates. The Task Force now assumes that the more probable growth of the phosphate industry in Southeastern Idaho will average about 3 percent per year as shown in Table 1-1-a.

On this basis, it is assumed the beneficating plant of the Diamond Creek area would be built in the late 1970's, and the beneficiating plant at the Paris-Bloomington area in the early 1980's. It is now unlikely that the proposed beneficiating plant in the Soda Spring area will be built; IMC has stated that it does not propose to begin mining in the foreseeable future, and it is known that the lease for the proposed Husky No. 1 Mine is available for sale.

Reactivation of the beneficiating plant in Georgetown Canyon is also improbable at this time.

Details of the planned new processing activities scheduled to begin between 1977 and about 1981 are given below.

Company	Type of plant[1]	Proposed startup date	Proposed location	Tentative proposed acreage	Ore processing capacity, MMTY[2]
Alumet	W-S-C	1977	Diamond Creek property	112-1,700[3]	2.5
Earth Sciences	W-S-C	1978	Bear Lake Valley area	55-530[4]	1.5
FMC	W-S	After 1980	Dry Valley property	110[5]	2.0
IMC	W-S-C	1978	Soda Springs area	1,300[6]	3.0

[1] W-S-C represents washing, sizing, and calcining; W-S represents washing and sizing only.

[2] Thousand thousand (or million) tons per year.

[3] If dry beneficiation proves feasible, no tailings ponds will be required and total plant acreage will be 112 acres. Otherwise, 1,588 acres are planned for tailings ponds.

[4] Includes tailings pond - 5,000 acre-feet, 10-year life. If 500 acres, pond will be 10 feet deep; if 25 acres, 200 feet deep (average) in dammed-off valley. High land value and earthquake potential will govern location and decision options.

[5] Reported as same size and acreage figure (110 acres) given by J. R. Simplot Co. for its existing Conda washing-sizing plant.

[6] Includes estimated 640 acres for settling ponds and 540-620 acres (perhaps high) for onsite roads, parking, railroad sidings, landscaping, staging areas, product storage piles, utilities substations, and other related support facilities.

B. PHOSPHATE LEASING PROCEDURES

1. AUTHORITY

Phosphate deposits on public domain lands, and those reserved to the United States in patented lands, are leased under the authority of the Mineral Leasing Act of 1920, 30 U.S.C. sec. 181 et. seq. Phosphate deposits on acquired lands are leased under the Mineral Leasing Act for Acquired Lands of 1947, 30 U.S.C. sec. 351-359. All leases, permits, and use permits, both issued and pending, within the study area are under the 1920 leasing act. Rules and regulations necessary to carry out the provisions of both acts are prescribed by the Secretary of the Interior.

The Act of March 18, 1960, 30 U.S.C. sec. 211, authorized the Secretary of the Interior to issue prospecting permits where prospecting or exploratory work is necessary to determine the existence or workability of phosphate deposits in any unclaimed, undeveloped area. A prospecting permit grants the exclusive right to prospect for phosphate deposits and associated minerals for an initial period of 2 years. A permit may be extended for an additional 4-year period, as deemed advisable by the Secretary. Discovery of a valuable deposit of phosphate entitles the permittee to a preference-right lease for all or part of the area specified in the permit.

Phosphate deposits may be leased by the Secretary to citizens of the United States, to associations of such citizens, or to any corporations organized under the laws of the United States, or any State or Territory thereof, when, in his judgment, it is in the public interest. Lands to be leased are described by legal subdivisions of the public-land surveys, are in reasonably compact form, and do not exceed 2,560 acres. Leases are offered through advertisement for competitive bidding and are issued for a term of 20 years and so long thereafter as the lessee complies with the terms and conditions of the lease. Leases are let on 40 acre blocks. At the end of each 20-year period, reasonable readjustments of the terms and conditions of the lease may be made as prescribed by the Secretary. Minimum annual lease rentals are 25 cents per acre for the first year, 50 cents per acre for the second and third years, and $1 per acre for each year thereafter. Royalty payments to the United States are fixed by the Secretary in advance of the lease offering at not less than 5 percent of the gross value of the output of the phosphate or phosphate rock and associated or related minerals.

The lessee may use silica, limestone, or other rock on the leasehold for processing or refining the phosphate upon payment of royalty as determined by the Secretary.

A phosphate lessee or permittee may be granted the right to use the surface of unappropriated and unentered public lands not a part of his lease or permit and not exceeding 80 acres in area, as may be determined by the Secretary to be necessary or convenient for the extraction, treatment, and removal of the mineral deposits. This provision is not applicable to national-forest lands.

Holdings in leases and permits applied for or issued under the Mineral Leasing Act of 1920 by any person, association, or corporation shall not exceed 20,480 acres in the United States.

All moneys received from lease bonuses, rentals, and royalties under the Mineral Leasing Act of 1920 are deposited into the general fund of the U.S. Treasury and are distributed as follows: 37.5 percent to the State containing the deposit, 52.5 percent to the Reclamation Fund, and 10 percent to the general fund. Payment to the State of Idaho are made semiannually to the Idaho State Treasurer. This money is transferred to the Idaho State Department of Education and allocated by a formula, established by the State legislature, to the 115 public school districts in the State. The Reclamation Fund moneys become a part of the annual appropriation to the Bureau of Reclamation.

Since the preparation of the draft statement a new State law and a new Federal law regarding the distribution of mineral leasing receipts have been enacted. The new State law, Section 57-1306, Idaho Code, provides that 10% of the moneys received by the State from the Federal government from sales, royalties, bonuses or rentals of oil, gas or mineral lands of the Federal government be dispersed to the counties impacted by mineral leases on a proportionate basis, and to provide that the remaining 90% of such moneys be deposited into the public school income fund. The moneys remitted by the various counties shall be used for the construction and maintenance of public roads or for the support of public schools. The new Federal law, entitled, "Federal Coal Leasing Amendments Act of 1975", was enacted on August 4, 1976. Section 9 of this act provides that 50% of all moneys received from sales, bonuses, royalties and rentals of public lands under the Mineral Leasing Act and the Geothermal Steam Act shall be returned to the State within the boundaries of which the leased lands or deposits are or were located. Distribution of mineral leasing receipts are now: 50% to the State; 40% to the Reclamation Fund, and 10% to the General Fund.

A bond of not less than $5,000, conditioned upon compliance with all the conditions of the lease, must be furnished on all leases issued. Prospecting permits require a bond of not less than $1,000. Statewide or nationwide bonds may be filed in lieu of individual lease bonds.

The regulations of the Secretary of the Interior pertaining to phosphate leasing are contained in 43 CFR Group 3500--Leasing of Minerals Other Than Oil and Gas. Regulation 43 CFR Part 23 provides for the protection of nonmineral resources during operations for discovery and development of minerals under permits and leases issued under the Mineral Leasing Act of 1920. A technical examination must be made of prospective surface exploration and mining operations; on the basis of this examination, special stipulations to assure protection of nonmineral resources and the environment are incorporated into the permit or lease. On lands administered by agencies other than the Department of the Interior, the administering agency must be contacted for its recommendations.

Under operating regulations of the Geological Survey, 30 CFR 231, exploration, mining, and reclamation plans must be approved before such operations commence on Federal permits or leases, and a bond adequate to cover reclamation requirements must be filed.

2. ADMINISTRATION

The Secretary of the Interior is directly responsible for administering the mineral-leasing laws. The minerals-management objectives of the Department of the Interior are for (1) orderly and timely resource development, (2) protection of the environment, and (3) the receipt of fair market value for disposition of the mineral resources. Two Interior agencies, the Bureau of Land Management and the Geological Survey, have been delegated administrative and management responsibilities for the Mineral Leasing Act and for the operating programs of the Department.

For the phosphate resources in Idaho, the Bureau of Land Management determines whether leases or permits will be issued, is responsible for their issuance, and is the office of record in mineral-leasing matters. The Geological Survey is responsible for supervising lease operations and for all geological, engineering, and economic-value determinations, which include the classification of lands for lease or for permit and the setting of rental and royalty rates as well as other terms and conditions to a permit or lease.

The two agencies mutually formulate the general requirements in leases and permits for protecting the surface and nonmineral resources and for reclamation. Both agencies also review mining and exploration plans and plans for abandonment of operations.

The Forest Service is responsible for managing the national-forest surface resources in accordance with Federal statutes and directives of the Secretary of Agriculture. This includes advance consideration of the effects of issuing leases and prospecting permits that may become preference-right leases. Before permits or leases on national-forest lands are issued, the Forest Service makes recommendations to the Bureau of Land Management on the leasing or permitting and on including special stipulations for protecting surface and nonmineral resources and for reclamation. The Forest Service consults with the responsible Interior agencies in all matters regarding prospecting permits and leases on national-forest lands and--except for mineral exploration, development, and production operations--supervises the surface uses on these lands.

On patented lands where the United States has reserved the phosphate deposits, the statutes provide for the right to prospect for, mine, and remove such deposits. Permittees and lessees, however, are liable for the payment of damages to crops and improvements and for any damage that may be caused to the value of the land for grazing.

C. PRESENT STATUS OF MINING AND PROCESSING

1. BACKGROUND

Phosphate deposits of the Western Field were originally recognized near La Plata in Cache County, Utah, in 1889. Development of the resource was slow because of remoteness from fertilizer markets.

Nevertheless, many mining claims were located on the phosphate deposits in the southeastern Idaho between 1900 and 1908. Because the deposits ranged from gently dipping to vertical, both lode and placer claims were staked. Disputes arising between rival claimants as to the proper type of claim led many prospectors to file claims under both the lode and placer provisions of the 1872 Mining Law. The Act of January 15, 1915, (39 Stat. 782; 30 U.S.C. 131) laid this matter to rest when it provided that placer claims located in good faith for phosphate were deemed to be valid locations. Before 1915, 23 phosphate lode claims involving about 440 acres of land were patented in Idaho. Placers were the favored mode of location as about 6,050 acres of land in 42 placer claims were patented.

This ready availability of land was short lived. On December 9, 1908, and December 4, 1909, the Secretary of the Interior withdrew all potentially valuable phosphate lands in Idaho, Utah, and Wyoming. About 4½ million acres of phosphate land--private, State, and Federal--were withdrawn. The phosphate withdrawals were prompted by the concern that the European corporations controlling the phosphate lands in Tennessee were exporting American fertilizer products for use in Europe. President Taft's State of the Union message in December, 1910 called for the separation of surface and mineral rights on Government phosphate lands with the power to lease such lands and with the condition that the Government regulate, and, if necessary, prohibit the export of phosphate to foreign countries.

The phosphate withdrawals were made by the Secretary of the Interior under the implied authority of the Executive. These were affirmed by Congress by the Pickett Act in 1910. The withdrawals precluded all location, settlement, selection, and sale of the lands under the Federal land and mineral laws. Because much of the land was valuable for agriculture, several laws were enacted between 1909 and 1914 that permitted sale of the lands but reserved to the United States the rights to the withdrawn minerals. The Act of February 27, 1913, enabled the State of Idaho to select under the indemnity selection laws parcels of the withdrawn lands, with phosphate and/or oil reserved to the United States. This act, along with the other surface-separation acts, were replaced by the Act of July 17, 1914 (38 Stat. 509; 30 U.S. 121). Within the Study area, the State of Idaho has obtained, by selection, about 124,000 acres of land with phosphate reserved to the United States.

A substantial amount of land in the study area has passed into private ownership with phosphate reserved to the United States under the 1914 Act and under the Stockraising Homestead Act of 1916, whereby all minerals are reserved to the United States.

Before Federal phosphate deposits became available for development under the Mineral Leasing Act of 1920, however, the U.S. Geological Survey had begun detailed studies to classify phosphate and nonphosphate lands within the withdrawals. Identification of billions of tons of phosphate in the Western Field allayed fears that domestic supplies might be depleted by exportation of the Tennessee and Florida phosphates. Consequently, land-classification studies slackened. The geological studies, however, resulted in a still continuing combined program of classification and areal and structural studies. In 1969, a total of 9,867 acres were evaluated by the Geological Survey in the Caribou Range as phosphate lands subject to competitive leasing only. Additional lands are being currently evaluated in southeastern Idaho for a similar designation.

2. PERMITS AND LEASES

Passage of the Mineral Leasing Act of 1920 did not cause an immediate rush to obtain leases on the Idaho phosphate deposits. Less than a dozen leases issued before World War II were all soon relinquished. All current leases in Idaho were issued between 1948 and 1969. There are 43,370 acres within the study area covered by Federal phosphate leases. Table 1-3 lists the Federal leases in Idaho.

Phosphate prospecting permits activity in Idaho was most intense during the middle and late 1960's. Table 1-3a shows this activity by years. Currently, there is one issued permit involving 475 acres of land.

3. MINING OPERATIONS AND PROCESSING PLANTS

Until 1946, only two significant phosphate mines were developed in Idaho: San Francisco Chemical Company's Waterloo mine, about 3 miles east of Montpelier, and Anaconda Copper Mining Company's Conda mine, about 6 miles north of Soda Springs.

The Waterloo mine was developed as an underground operation in 1907 and produced until 1929. The property was reactivated in 1945 as a surface mine and operated until 1958, although some ore was produced in 1960. Total production from this mine was about 1¼ million tons.

The Conda mine property, about 3,400 acres of patented placer claims, was purchased by the Anaconda Company from the Southern California Orange Grove Fertilizer Company in 1919. Underground operations began in 1920 and continued until 1957. Principal production came from the west limb of the Trail Creek syncline. About 3 million tons of phosphate rock were produced from the underground operation. Surface mining was begun in 1952 to supplement underground production, but since 1957, it has been the sole source of production. In 1959, the J. R. Simplot Company acquired both the mine and the beneficiation-plant facilities, from which the beneficiated phosphate rock is shipped by rail to the Simplot fertilizer plant near Pocatello.

In 1946, the Gay mine was developed as an open-pit mine by the J. R. Simplot Company in association with Westvaco Chemical Company

Table 1-3.--Federal phosphate leases in southeastern Idaho study area

Serial number	Type[1]	Date	Original lessee	Acreage	Present lessee
I-014914	PR	5/1/70	E. B. Archer	184.95	Alumet Group[2]
I-014958	PR	5/1/69	E. B. Archer	400.00	do.
I-014959	PR	7/1/69	J. D. Archer	360.00	do.
I-014978	PR	7/1/69	E. B. Archer	360.00	do.
I-015259	PR	8/1/69	J. D. Archer	280.00	do.
I-016179	PR	5/1/69	J. D. Archer	40.00	do.
I-04	C	10/1/50	Western Fertilizer Assn.	1,522.24	Beker Industries
I-04979	C	4/1/54	F. P. Champ	321.25	do.
I-012989	C	11/1/62	J. D. Archer and W. J. Colman	560.00	do.
I-013731	C	8/1/63	F. P. Champ	360.00	Frederick P. Champ and Williams family partnership
I-012982	C	7/1/62	Ruby Co.	65.74	Earth Sciences, Inc.
I-02272	C	11/1/51	FMC Corp.	80.00	FMC Corporation
I-05975	C	6/1/55	J. A. Terteling Co.	620.88	do.
I-08194	C	5/1/57	J. A. Terteling Co.	1,636.98	do.
I-011775	PR	8/1/65	FMC Corp.	560.00	do.
I-011866	PR	2/1/67	FMC Corp.	396.74	do.
I-011877	PR	12/1/66	FMC Corp.	835.47	do.
I-013215	PR	12/1/66	FMC Corp.	481.12	do.
I-013729	PR	6/1/67	FMC Corp.	120.00	do.
I-014184	PR	4/1/68	FMC Corp.	320.00	do.
I-014664	PR	4/1/68	FMC Corp.	1,159.34	do.
I-015033	PR	9/1/68	FMC Corp.	160.00	do.
I-015035	PR	3/1/69	FMC Corp.	200.00	do.
I-015041	PR	7/1/69	FMC Corp.	520.00	do.
I-015097	C	9/1/64	FMC Corp.	719.38	do.
I-015122	C	9/1/64	FMC Corp.	360.00	do.
I-015821	C	9/1/65	FMC Corp.	120.43	do.
I-015940	PR			520.00	do
I-05549	C	6/1/56	Husky Oil Co.	864.35	Int. Min. & Chem. Co.
I-07239	C	6/1/56	Husky Oil Co.	640.00	do.
I-07240	C	6/1/56	Husky Oil Co.	469.85	do.
I-07942	C	5/1/57	Husky Oil Co.	1,249.00	do.

[1] PR, preference-right lease; C, competitive lease; NC, noncompetitive lease.
[2] Earth Sciences, Inc., National Steel Co., and Southwire Co.

Table 1-3.--Federal phosphate leases in southeastern Idaho study area--Continued

Serial number	Type[1]	Date	Original lessee	Acreage	Present lessee
B1-055875	C	12/1/48	J. R. Simplot Co.	280.95	Monsanto Co.
B1-055894	C	12/1/48	J. R. Simplot Co.	200.00	do.
B1-056009	C	12/1/48	J. R. Simplot Co.	200.00	do.
B1-056192	C	9/1/49	J. R. Simplot Co.	65.34	do.
I-01	C	9/1/49	J. R. Simplot Co.	200.00	do.
I-02	C	9/1/49	J. R. Simplot Co.	120.00	do.
I-03	C	9/1/49	J. R. Simplot Co.	160.65	do.
I-016	C	9/1/49	J. R. Simplot Co.	160.00	do.
I-0257	C	11/1/49	J. R. Simplot Co.	120.00	do.
I-0258	C	11/1/49	J. R. Simplot Co.	80.00	do.
I-0678	C	12/1/51	J. R. Simplot Co.	200.00	do.
I-0997	NC	10/1/50	J. R. Simplot Co.	671.25	do.
I-01005	NC	10/1/50	J. R. Simplot Co.	200.00	do.
I-01440	C	10/1/50	J. R. Simplot Co.	1,080.00	do.
I-01441	C	10/1/50	J. R. Simplot Co.	438.29	do.
I-05613	C	6/1/5	Monsanto Co.	520.00	do.
I-05723	NC	7/1/55	Monsanto Co.	668.91	do.
I-05860	NC	7/1/55	Monsanto Co.	120.00	do.
I-011451	C	9/1/60	Monsanto Co.	1,402.85	do.
I-013709	PR	12/1/65	Monsanto Co.	80.00	do.
I-013719	PR	3/1/69	Mountain Fuel Supply Co.	520.00	do.
I-013720	PR	10/1/68	Mountain Fuel Supply Co.	200.00	do.
I-013738	PR	11/1/66	Charles Holland	212.28	do.
I-013814	PR	12/1/65	Monsanto Co.	40.00	do.
I-014080	C	1/1/64	Monsanto Co.	697.08	do.
I-014081	C	1/1/64	Monsanto Co.	1,680.00	do.
I-016002	C	9/1/66	Monsanto Co.	240.00	do.
I-017042	PR	1/1/69	Monsanto Co.	80.00	do.
I-013649	PR	12/1/66	Mountain Fuel Supply Co.	120.00	Mountain Fuel Supply Co.
I-06433	NC	8/1/59	E. A. Rasmussen	1,604.90	E. A. Rex[3]
I-06638	NC	8/1/59	E. A. Rex Mining Co.	1,520.00	do.
I-010763	NC	8/1/59	E. A. Rex Mining Co.	1,416.84	do.
I-010764	NC	8/1/59	E. A. Rasmussen	1,363.95	

[1] PR, preference-right lease; C, competitive lease; NC, noncompetitive lease.

[3] Wells Cargo, Inc.

Table 1-3.--Federal phosphate leases in southeastern Idaho study area--Continued

Serial number	Type[1]	Date	Original lessee	Acreage	Present lessee
B1-055163	C	2/1/49	Christensen and Cox	160.00	J. R. Simplot Co.
I-01603	NC	3/1/52	Anaconda Co.	688.08	do.
I-04494	C	9/1/54	Anaconda Co.	476.48	do.
I-09945	C	6/1/59	J. R. Simplot Co.	1,763.34	do.
I-010333	C	6/1/59	J. R. Simplot Co.	477.82	do.
I-015523	C	8/1/65	Ruby Co.	80.00	(Simplot Ind., Inc.)
I-015820	C	8/1/65	Ruby Co.	80.00	do.
I-011683	PR	5/1/63	Ruby Co.	120.00	(Bannock Chem. Co.)
I-012890	C	10/1/62	Ruby Co.	2,520.00	do.
I-04373	C	9/1/53	J. A. Terteling Co.	427.73	Stauffer Chem. Co.
I-04374	C	9/1/53	J. A. Terteling Co.	520.00	do.
I-04375	C	9/1/53	J. A. Terteling Co.	800.00	do.
I-04775	C	6/1/55	J. A.Terteling Co.	440.00	do.
I-07238	C	6/1/56	San Francisco Chem. Co.	518.12	do.
I-07619	C	3/1/57	J. A. Terteling Co.	360.00	do.
I-07881	C	5/1/57	San Francisco Chem. Co.	360.00	do.
I-015040	PR	10/1/69	FMC Corp.	120.00	do.
I-97	PR	8/1/69	Stauffer Chem. Co.	307.99	do.

[1] PR, preference-right lease; C, competitive lease; NC, noncompetitive lease.

Table 1-3a.--PHOSPHATE PROSPECTING-PERMIT ACTIVITY

	PERMITS						PREFERENCE-RIGHT LEASES			
Fiscal Year	Applications	Acres	Issued	Acres	Pending	Acres	Pending	Acres	Issued	Acres
1960	2	626	1	440	0				1	120
1961	13	10,541	4	3,589	0				3	1,792
1962	3	715	1	321	0				1	321
1963	18	18,435	14	5,615	0				8	1,772
1964	44	18,689	37	9,973	0				10	3,744
1965	78	64,812	44	23,808	0		1	1,232	2	480
1966	34	15,889	19	6,658	0				2	926
1967	36	18,871	22	10,922	0		1	492	1	388
1968	24	13,172	15	8,972	0		1	720		
1969	26	10,156	10	4,443	1	80	1	80		
1970	6	1,978	4	807	0					
1971	15	3,793	1	120	12	2,953				
1972	8	1,052	0		7	932				
1973	4	1,000	0		3	880				
1974	28	56,599	0		28	56,599				
1975	88	116,298	0		47	59,593				
	427	352,626	172	75,668	98	121,037	4	2,524	28	9,543

(FMC), on the Fort Hall Indian Reservation on leases obtained from the Shoshone-Bannock Indian Tribe. About 32 million tons of phosphate rock have been mined to date. The rock is transported by rail to Pocatello where it is processed in Simplot's fertilizer plant and FMC's elemental phosphorus plant.

In 1951, the Monsanto Chemical Company (now the Monsanto Company) purchased 15 Federal phosphate leases from Simplot. During 1952, Monsanto developed the Ballard mine on Federal leases and began construction of its elemental-phosphorus plant north of Soda Springs. The Ballard mine operated continuously until 1969 and produced about 11 million tons of phosphate rock. In 1969, Monsanto began operating the Henry mine, from which rock is hauled in large, three-unit truck trains 16.5 miles to the plant.

Central Farmers Fertilizer Cooperative operated an open-pit mine on patented mining claims on Snowdrift Mountain from 1958 to 1963. In 1959, it constructed an elemental-phosphorus plant and a fertilizer plant in Georgetown Canyon, about 7 miles northeast of Georgetown. El Paso Products Company purchased all holdings of Central Farmers in 1964, but there has been no further mining in Georgetown Canyon and the plants have been partially dismantled.

Included in the holdings purchased by El Paso was the Maybe Canyon property, Federal phosphate lease, I-04, on the east side of Dry Valley. In 1964, El Paso began to develop the Maybe Canyon mine on this lease and to construct a fertilizer-processing complex near Conda, with an 18-mile railroad spur between the plant and the mine. In 1967, El Paso stopped production because of the depressed fertilizer market. In 1970, it sold its holdings to Agricultural Products Company, a subsidiary of Beker Industries.

Mountain Fuel Supply Company started to develop a mine in Upper Dry Valley on a Federal phosphate lease obtained from W. J. Coleman and J. D. Archer in 1963 and constructed a beneficiation plant adjacent to the existing El Paso Products fertilizer plant. The Mountain Fuel mine never produced and both the mine and plant have been sold to Beker Industries.

In 1966, Stauffer Chemical Company, the successor to San Francisco Chemical Company, purchased all Federal leaseholds of the J. A. Terteling Company. The Wooley Valley mine, begun in 1967, is still operating, and phosphate rock is shipped by rail to Stauffer processing plants at Silver Bow, Montana, and Leefe, Wyoming.

Total production of phosphate rock in Idaho through 1974 has been about 75 million short tons, of which 34 million tons have been from Indian lands, 28 million tons from Federal leases, and 13 million tons from private lands. Income to the Federal Government from royalties, bonus bids, and rentals has amounted to about $12 million. Of this, $6.3 million went to the Reclamation Fund; $4.5 million to the State of Idaho; and $1.2 million to the general fund of the U.S. Treasury.

Investments in phosphate mines and plants in the area was $654,725,000 in 1966; according to one company, it probably now approaches $1 billion.

D. PHOSPHATE IN THE LOCAL, REGIONAL, AND NATIONAL ECONOMY-- A SUPPLY AND DEMAND FORECAST

1. U.S. AND WESTERN STATES PRODUCTION AND CONSUMPTION

The United States produced 45.7 million short tons of marketable phosphate rock in 1974. The sources of supply are the principal producing areas of Florida, North Carolina, Tennessee, and the Western States.

The Western States forming the western phosphate field, which comprises parts of Idaho, Montana, Utah, and Wyoming, produced about 14 percent of the U.S. total, or 6.3 million tons. Of this, 3.3 million tons were smelted in electric furnaces to produce elemental phosphorus; 2.0 million tons were used for agriculture fertilizers and animal feed supplements; and about two-thirds of a million tons were exported, principally to western Canada. Southeastern Idaho, whose estimated 1 billion tons of phosphate-rock reserves constitute about 80 percent of the western phosphate field reserves, produced 4.8 million tons in 1974, or about 11 percent of the U.S. total.

In 1975, the U.S. phosphate rock production increased 7 percent over 1974 to 49 million short tons, and the value jumped 76 percent to $882 million. The price of phosphate rock, stimulated by an exceptionally strong demand for phosphatic fertilizer, rose to unprecedented levels at the beginning of 1975. Moroccan export prices ranged from $55.11 to $69.40 per short ton f.a.s. Casablanca, and the U.S. export prices varied from $32.66 to $56.25 per short ton f.o.b. Tampa. Resistance to 1975 fertilizer prices developed early in the year, with the result that both fertilizer and phosphate rock inventories increased sharply, and fertilizer prices declined by 30 to 60 percent. North African phosphate rock producers began discounting contract prices by 20 percent or more, and the shift from a seller's to a buyer's market occurred. Although U.S. production increased, world production declined by 4 percent.

2. DEMAND FORECAST FOR U.S. AND WESTERN STATES PHOSPHATES AND THE INFLUENCE OF FLORIDA, NORTH CAROLINA, AND TENNESSEE PRODUCTION

The domestic demand for phosphate rock, according to the U.S. Bureau of Mines in 1974 was expected to increase at an annual growth rate of 3 percent until at least the end of the century; after 2000, it may decline to 2 percent per year. A phosphate-rock supply-and-demand projection for the United States is shown in Figure 1-3. The demand curve for the United States intercepts the U.S. production curve around 2005, assuming an either 2- or 3-percent annual growth rate. Although this projection indicates that U.S. demand will not exceed supply until after 2000, it does not recognize the effect of restricted markets from each producing area of the country. The demand curve intercepts the Florida supply curve between 1990 and 1995 and, since Florida is the

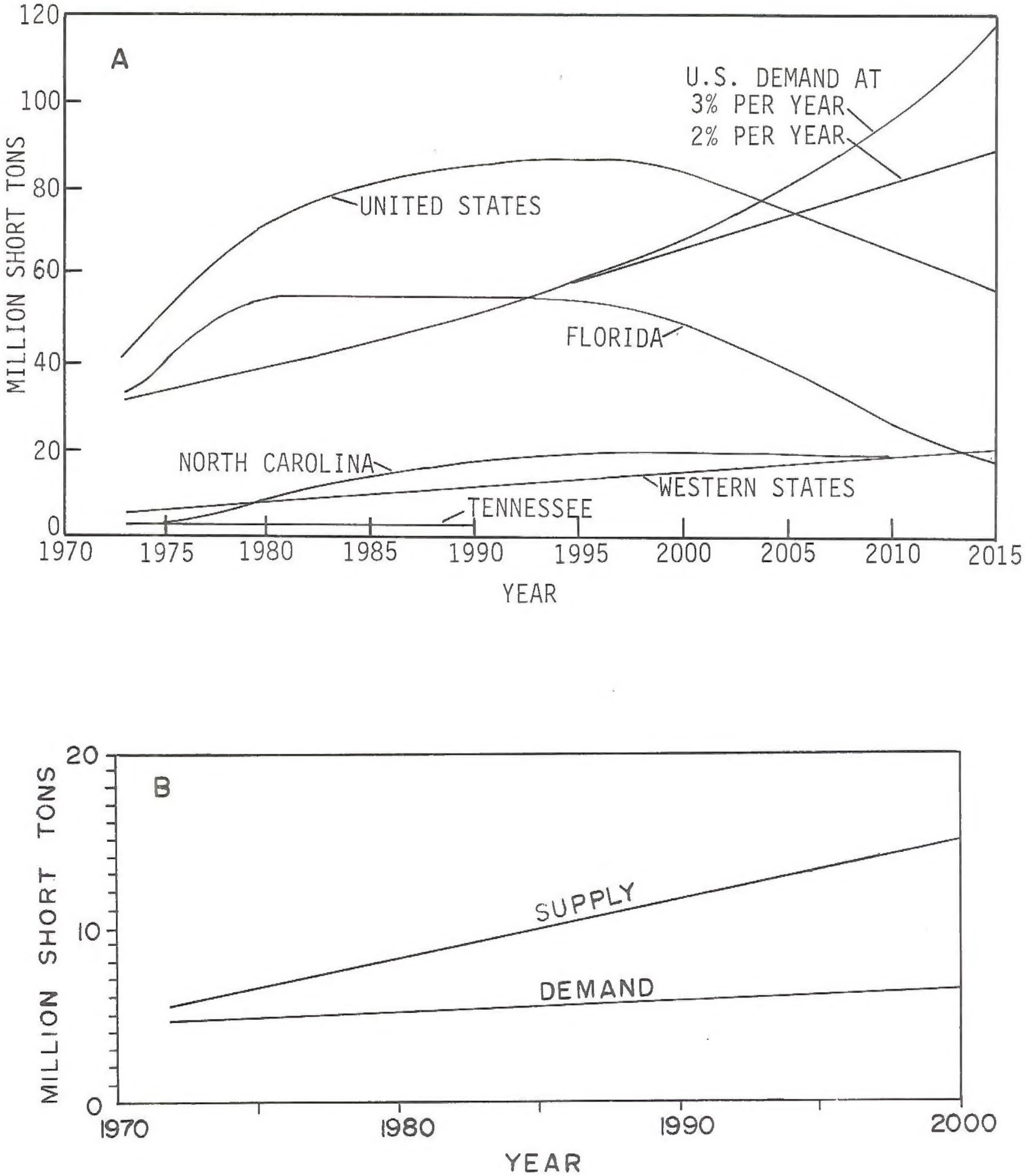

Figure 1-3.--Supply and demand projections for phosphate rock, in millions of short tons: A, in the United States from 1973 to 2015; B, in the Western States from 1973 to 2000. Data from U. S. Bureau of Mines, 1974.

principal supplier of phosphate rock for U.S. agriculture demand, the problem of adequate supply for the United States is expected to materialize on or before this time. The production from Tennessee that is smelted in electric furnaces is expected to phase out by 1990. Production from mines in North Carolina is expected to increase to about 20 million tons per year by 2000. This production, like the current production from North Carolina, will probably be converted into phosphatic fertilizers and marketed in the Eastern and Midwestern United States. Production in the Western States is expected to increase to meet the total demand for phosphate rock in the western agriculture market, to compete in the western Canadian market, and to supply derivatives of elemental phosphorus to U.S. markets. Production of elemental phosphorus or furnace-grade phosphoric acid, either from electric furnaces or by refining wet-process phosphoric acid, will probably make up production losses from Tennessee after 1985.

The U.S. Bureau of Mines 1974 domestic supply-and-demand forecast for western phosphate rock is shown in Figure 1-3a; the supply forecast was developed by summarizing the production estimates of the operating companies. The production forecast of 15 million tons of marketable phosphate rock by 2000 could be supported by reserves in this field. Furthermore, an export demand for western phosphate rock would have to develop to absorb projected production in excess of projected domestic demand. Western producers are expected to continue to supply the demand in the Western States for agriculture fertilizers, but agriculture fertilizers from Florida and North Carolina phosphate rock will probably dominate the supply in the United States, except for those markets relatively near western producers. The projected excess production from the Eastern United States--the difference between U.S. supply and demand in Figure 1-3a--will probably be exported, not only to world markets but to markets on the west coast of the United States and in western Canada, thereby influencing the future markets for western U.S. phosphate rock.

3. AGRICULTURAL AND INDUSTRIAL DEMANDS ON WESTERN STATES PHOSPHATES

A major demand for Western States phosphate rock is for electric-furnace production of elemental phosphorus (P_4), which is used in numerous nonacid products but primarily to produce thermal acid. Of the 3.3 million tons of phosphate rock smelted to P_4 in 1974, about 85 percent of the P_4 was converted to phosphoric acid, and 15 percent was used in nonacid applications. A detailed breakdown of the 85 percent of thermal acid shows that 75 percent of the P_4 was used for industrial phosphate and acid; 8 percent, for fertilizers; and 2 percent, for animal feeds. Nonacid uses included the production of the anhydrous derivatives PCl_3, $POCl_3$, and P_2S_5; other chemicals and alloys; and P_4 for munitions and pyrotechnics. A detailed breakdown of the 75 percent of industrial phosphate and acid products shows that 48 percent of the total thermal-acid P_4 was for detergents and water conditioners (chiefly as sodium tripolyphosphates--STPP); 10 percent, for food additives; 8

percent, for metal treatment; and the remaining 9 percent, for other, miscellaneous applications. The markets are identified to indicate that almost half of the P_4 was converted to STPP; because of opposition to STPP entering streams and lakes, growth of this market is expected to remain stable or decline. However, the overall domestic demand for western phosphates, as shown in Figure 1-3b, is expected to increase at an average growth rate of 1 percent per year.

4. CURRENT OUTLOOK

From 1960 to 1968, United States consumption of phosphate rock increased from 19.3 million tons to 37.8 million tons. During this period, major producers greatly expanded their production capacity. The demand, however, declined in 1967 at about the time much of the new production capacity was completed, and the domestic phosphate industry ended the 60's with one of the most pronounced over-capacities in its history.

About 1970 the demand again increased, and grew at an annual rate of 5 to 5½ percent from 1970 to 1974, reaching a total of 48.4 million tons in 1974. Supply, however, was insufficient to meet demand and prices rose drastically. This in turn led to new expansion plans and brought new companies into the phosphate field. The cumulative effect of plans by existing companies to expand operations in southeast Idaho and plans of other companies to start operation in the area was one of a major expansion of the industry.

Each of eight companies, working independently, took an optimistic view of its ability to capture a sizeable portion of an apparently rapidly-growing market. As a result and at the request of the Geological Survey eight companies filed 16 mining plans with the USGS, and these were evaluated in this draft Environmental Impact Statement. The sum of these plans far exceeded even the most optimistic predicted growth rate; however, the very filing of these plans mandated that the draft Environmental Impact Statement address each individual mining plan and the sum of all 16 plans.

In 1975, consumer resistance to high prices caused sales and prices to drop and the year closed with high warehouse inventories of phosphate fertilizers. The 1976 market is cautiously improving, and a revised, more realistic, estimate of future production has emerged from industry.

Tom A. Blue, of Stanford Research Institute of Menlo Park, California, in testimony at the public hearings on June 7, 1976, estimated that 1980 United States demand would not exceed the 1974 level and the demand for Western phosphate rock would be about 7.4 million tons in 1980, about 11.0 million tons in 1990, and about 14.0 million tons in the year 2000.

Mr. John R. Sunnygard, Chemical Market Manager for the Union Pacific Railroad, in testimony at the public hearings on September 13, 1976, indicated that a growth rate under three percent would be expected, reaching an annual rate slightly under 15 million tons by the year 2000.

In August, 1976, the Interagency Task Force asked each of the eight mining companies to re-examine their expected gorwth rate and to advise the Task Force of any change of plans. Their responses were as follows. Alumet hopes to bring the Diamond Creek mine into production at the earliest possible date at their original design production rate of 2.5 million tons per year. Beker expects to grow from a present annual rate of 2.0 million tons to 4.5 million in 1980 and hold that rate through the rest of the century. Earth Sciences, Inc., hope to bring their Paris-Bloomington Mine into production in the mid-80's at the earliest at 1.1 to 1.6 million tons per year. FMC does not expect to open their Dry Valley Mine until late in 1980 decade. Production rate would be at 2.0 million tons per year. IMC has indefinitely deferred plans to develop the Husky No. 1 lease. Monsanto plans no increase in production for the rest of the century. Mine production will be about 1.1 million tons per year. Simplot Company indicated no change in their plans. Stauffer expects to produce about 0.9 million tons per year in 1976 and 1977, then increase to about 1.2 million tons per year for the rest of the century.

Figure 1-1-a attempts to reconcile the foregoing production plans for the separate companies with the area growth rate predictions previously cited. Starting dates and growth rates have arbitrarily been adjusted to approximate the growth rate predicted for the area. An analysis of impacts at this more probable growth rate, based upon mining as assumed in figure 1-1-a, has been added to this FES. As stated previously, the Conda mine is on patented mineral lands, and the Paris-Bloomington mine is essentially privately-owned minerals rights. All other production will be from existing leases, except Diamond Creek which includes an application for 650 fringe acres as an integral post of the mining plan.

Subsequent to reevaluation of the production schedule by industry in September, 1976, the Bureau of Mines has reevaluated its forecast for phosphate rock from the western phosphate field. The Bureau of Mines now projects a significant reduction below that projected by industry and others at the public hearings. In its mineral commodity profile on phosphate, prepared by William F. Stowasser in May 1977, the Bureau of Mines projects that production from the western States of Idaho, Utah, and Wyoming will increase slowly to about 8 to 10 million tons per year by the year 2000. Although impacts analyzed in this FES are at a higher level of production than proposed by the Bureau of Mines, actual production from both Federal and private mineral estates will be governed by market demands and other factors and may in the long term, be less than those discussed in this FES.

Of the actions discussed in this EIS, the Secretary of the Interior has authority to act upon the mining and reclamation plans submitted for approval, the fringe acreages applications, the preference right lease applications, the competitive lease sale applications, and the prospecting permit applications. He also has authority to readjust terms and conditions on 29 leases more than 20 years old.

CHAPTER II
DESCRIPTION OF THE EXISTING ENVIRONMENT

A. NATURAL ENVIRONMENT

1. CLIMATE

Climate in the study area is influenced by major topographic features, including the Pacific coast ranges and, more locally, the Bear River, Chesterfield, and other mountain ranges. The mountain ranges trend north and south and are almost at right angles to the prevailing eastward airflow, affecting wind, precipitation, and temperature patterns. Pacific air currents drop much of their moisture on the coast and other ranges to the west before they enter the study area.

Some of the lower elevations are in the Pocatello area in the southeast corner of the Snake River Plain, where the climate is desert-like. To the east and southeast, the ground level rises toward the Columbia River and Great Basin Divide, reaching an elevation of 9,957 feet at the top of Meade Peak, where the climate is moist and near polar.

Although variability of the climate limits the value of averages, some generalities are valid. In winter, persistent west winds bring mild weather into the area from the Pacific coast, but for periods of several days temperatures stay well below 0° F. Cloudy and unsettled weather prevails throughout the winter, with measurable precipitation on about one-third of the days, and snow prevails on the hills and mountains. The weather warms gradually in the spring, but freezing often persists at night until May at the lower elevations because of radiational cooling. Frost hazard persists all summer at the higher elevations. Normally, spring months are the wettest and windiest. Cool nights and warm to hot days are common during summer. Precipitation in summer is limited to localized showers. Possible sunshine averages more than 80 percent in July, August, and September, and almost 70 percent in May, June, and October. Exceptionally fine weather predominates in autumn. Pleasant daytime temperatures are common until November. The summer showers are gradually replaced by unsettled weather and more general rains, and general snowcover usually begins in November or December.

According to the Koppen Classification System (Petterssen, 1958), the valleys ranging in elevation from about 4,500 to 6,500 feet have a middle-latitude steppe climate, with dry summers ranging from warm to hot. Winters are cool to cold. Several feet of total snowfall and long periods of accumulated snow cover as thick as several feet are common. The climate on the higher mountains, some above 9,000 feet, is cool or cold snow forest with summer dryness; periods of snow cover are much longer than in the valleys, and snowfall and accumulated snow are considerably greater. Climate in the remainder of the study area ranges between those of the valleys and the higher mountains.

Large diurnal ranges of temperature result from intense heating by the sun during many cloudless days and radiation cooling at night. Air masses from the Pacific Ocean flowing into the area moderate temperatures to levels that are cooler during the summer and warmer during the winter than they are at similar latitudes and elevations east of the Continental Divide. Occasionally, arctic air masses move down the Rocky Mountains and spill westward over the divide, bringing extreme cold into the area.

Weather records are available at 10 U. S. Weather Bureaufor sites within the area. Additional records are available for nearly 40 storage-precipitation gages or snow courses that are observed a few times a year. These data are not sufficient to define the variations of some elements of the climate accurately at all points, but they are adequate for generalizations of the climatic characteristics.

Voluminous detailed records including wind speed and direction, dewpoint, air and ground temperatures, and percipitation have been collected since August 1975 by Greiner Environmental Services, Inc., for Alumet at three air-quality monitoring sites. These sites are located at Cellan Ranch near China Hat, at Diamond Creek minesite, and on Dry Ridge south of South Maybe mine. Records are available for four months, August to November 1975. These short-term records are useful to correlate with nearby long-term records to define dispersion conditions at the monitoring sites. In general, the data confirms the regional climate described in this section.

Quantity, timing, and type of precipitation vary considerably over the area. Mean annual precipitation ranges from less than 10 inches in portions of the wide Bear Lake and Snake River Valleys to more than 45 inches on some of the higher mountains (fig. 1-4). In general, precipitation increases with elevation, but steepness and direction of slopes, orientation, height of ridgetops, direction of prevailing winds, and other features also exert considerable control over the amount of precipitation. The barrier effect of large mountains causes increased precipitation upwind for many miles. The shadow effect causes noticeably less precipitation on the leeward side, except for the spillover area on the lee side of mountain tops. In addition to the mountain effects, other mechanisms, such as low-pressure systems and convective thunderstorms, cause added precipitation. Increased precipitation at higher elevations is considerably greater in winter than in summer. Precipitation data are summarized for Pocatello Airport, Idaho, Conda, Idaho, and Afton, Wyo. in table 1-4.

Less than half of the precipitation falls from April through September. Much of the precipitation from October to March falls as snow--the proportion increasing with altitude and far exceeding 50 percent in the higher mountains.

Snowfall and snow depths vary widely, as seen in table 1-4. Annual snowfall for 42 years of record at Pocatello Airport averaged 39.8 inches and ranged from 69.1 inches to 14.8 inches. For 32 years of record at Conda, it averaged 117 inches and ranged from 160 inches to 64.6 inches. Few data on snowfall at high elevations are available, but totals are considerably larger than those just noted. Accumulated

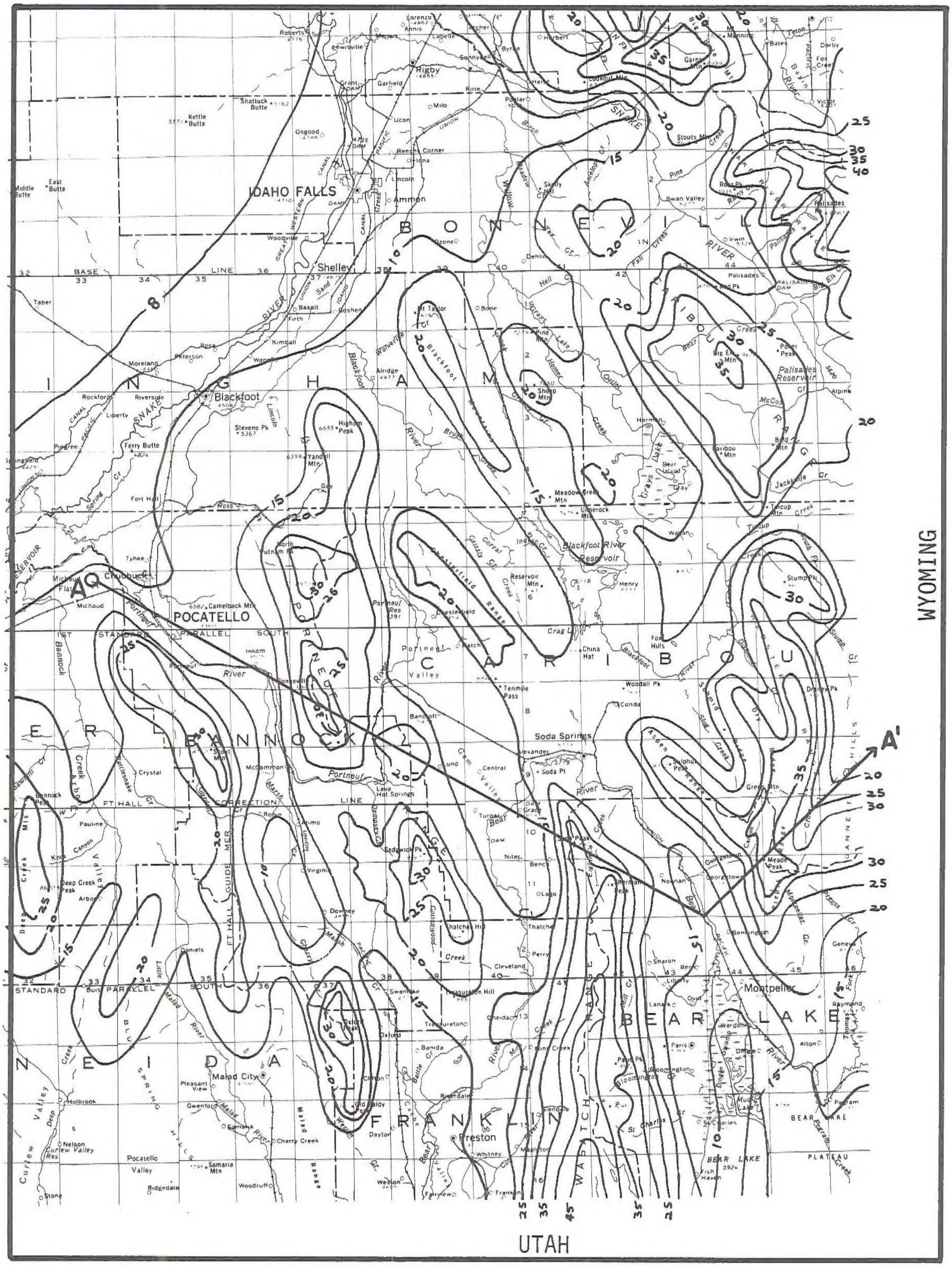

Figure 1-4.--Mean annual precipitation, in inches. Data from several sources, including published maps, and weather and snow-course records. Line A-A' is line of section in figure 1-6.

Table 1-4 --Total precipitation, in inches, at Pocatello Airport, Conda, Idaho, and Afton, Wyo., during periods indicated. T=trace

Month	Mean monthly or yearly	Greatest monthly or yearly	Least monthly or yearly	Greatest one day	Mean monthly or yearly snowfall
POCATELLO AIRPORT[1]					
	(1934-73)	(1938-73)	(1938-73)	(1900-73)	(1931-73)
Jan.	1.22	2.92	0.27	1.46	10.2
Feb.	1.00	1.87	.12	1.07	6.6
Mar.	1.16	2.63	.10	1.61	5.9
Apr.	1.29	3.30	.19	1.25	3.6
May	1.30	3.11	.05	1.67	.3
June	1.10	3.39	.03	1.65	0
July	.63	1.84	T	1.75	0
Aug.	.70	3.98	T	1.90	0
Sept.	.84	3.80	T	2.60	.1
Oct.	1.00	3.17	T	1.30	1.6
Nov.	.98	2.44	.02	.93	3.8
Dec.	1.08	2.95	.20	1.15	7.7
Year	12.30	16.83	5.34	2.60	39.8
CONDA, IDAHO[2]					
	(1939-73)	(1939-73)	(1939-73)	(1939-73)	(1941-73)
Jan.	1.96	4.57	T	1.12	27.8
Feb.	1.47	3.18	0.38	.70	19.4
Mar.	1.42	3.41	.33	.94	18.0
Apr.	1.71	3.09	.27	1.54	9.7
May	1.97	4.31	.15	1.75	1.4
June	2.12	5.25	.32	2.07	.1
July	0.82	2.08	T	1.05	0
Aug.	1.02	2.99	T	.85	0
Sept.	1.51	3.77	.08	1.50	.3
Oct.	1.35	3.44	0	1.35	5.3
Nov.	1.84	4.07	T	1.25	14.0
Dec.	1.98	6.57	.32	1.47	21.1
Year	19.17	29.71	13.19	2.07	117.1

Table 1-4--Total precipitation, in inches, at Pocatello Airport, Conda, Idaho, and Afton, Wyo., during periods indicated--Continued

Month	Mean monthly or yearly	Greatest monthly or yearly	Least monthly or yearly	Greatest one day	Mean monthly or yearly snowfall
			AFTON, WYO.[3]		
	(1931-73)	(1903-67)	(1903-67)	(1932-65)	(1931-73)
Jan.	1.52	3.59	0.03	1.12	19.2
Feb.	1.49	3.56	.17	1.10	17.0
Mar.	1.10	4.00	.03	1.54	14.6
Apr.	1.79	3.05	.12	1.58	9.3
May	2.04	6.50	.16	1.60	1.8
June	2.18	5.38	.21	1.75	.2
July	.85	3.85	.01	1.29	0
Aug.	1.03	3.78	0	1.04	0
Sept.	1.55	4.27	.05	1.41	.5
Oct.	1.20	4.84	0	1.66	3.4
Nov.	1.57	4.50	0	1.00	13.7
Dec.	1.62	4.06	.09	1.67	16.6
Year	18.04	26.41	12.35	1.75	96.3

[1] Elevation 4,447 feet.
[2] Elevation 6,200 feet.
[3] Elevation 6,210 feet.

depths of more than 6 feet of snow (usually much smaller than total snowfall) have been recorded at a snow course on Slug Creek divide. Snow accumulates to great depths in drifts, especially around patches of trees and on the leeward side of some ridges. Greiner Environmental Services reports snowdrifts 30 feet deep and up to 6 miles in length can form on the ice slopes of the ridges. Other areas, such as the windward side of exposed, untimbered ridges, are swept bare of snow by winds.

Thunderstorms accompanied by intense precipitation occur in small cells over the basin. The frequency of these events is not known. The orientation of some ridges and mountains, relative to prevailing or recurring patterns of airflow, appears to be related to the triggering of heavy precipitation at some sites more often than at others. The maximum precipitation of record in the study area on 1 day was 2.60 inches at the Pocatello Airport in September 1929.

Mean monthly temperatures at Pocatello, about the lowest elevation and the warmest point in the study area, range from 24° F in January to 74° F in July (fig. 1-5). Maximum and minimum temperatures of record are 104° F and -30° F, respectively. The diurnal range is normally about 40° F in the summer and about 20° F in winter.

In general, temperature decreases as altitude increases. The rate of decrease vertically (the lapse rate) averages about 3.6° F per 1,000 feet of rise. Records for the study area agree reasonably well with this value.

Short-distance temperature changes related to elevation are illustrated in figure 1-6, where estimated ground-surface temperatures are plotted along the line A-A' of figure 1-6, from Pocatello Airport to Meade Peak to Afton, Wyo.

The structure of the air is influenced, among other things, by solar radiation, temperature, cloud cover and wind speed and direction: masses of different temperatures and temperature increases vertically temperature in a vertical air column increases with temperature an inversion occurs. The vertical variations may differ, depending on time of day, season, humidity, and storms.

Figure 1-7 shows some typical air-temperature profiles and the duration and frequency of inversions, both measured at the Idaho National Testing Laboratory about 45 miles northwest of Pocatello. Similar variations probably also occur in the study area. Figure 1-7 shows three inversions (at hours 0858 and 1407 in winter, and 0530 in summer) when air temperature increased with elevation. This condition traps air near the ground and severely limits dispersion of air contaminants. The more normal profile shown for time 1158 closely follows the average lapse rate and represents a situation conducive to dispersing air pollutants. The probability of various types of profiles--their occurrences and durations--has not been well documented in the study area.

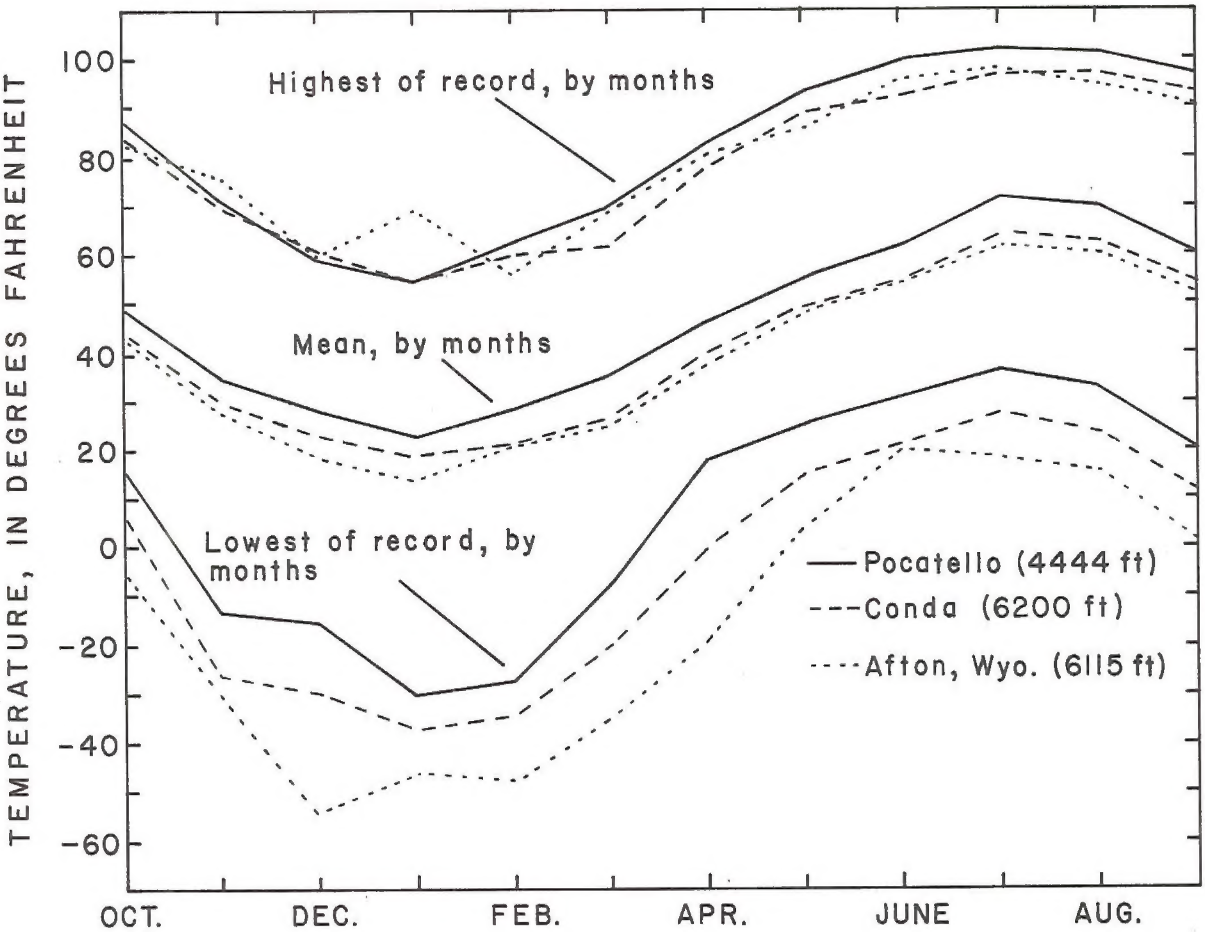

Figure 1-5.--Maximum, mean, and minimum temperatures of record, by month, at Pocatello and Conda, Idaho, and at Afton, Wyoming.

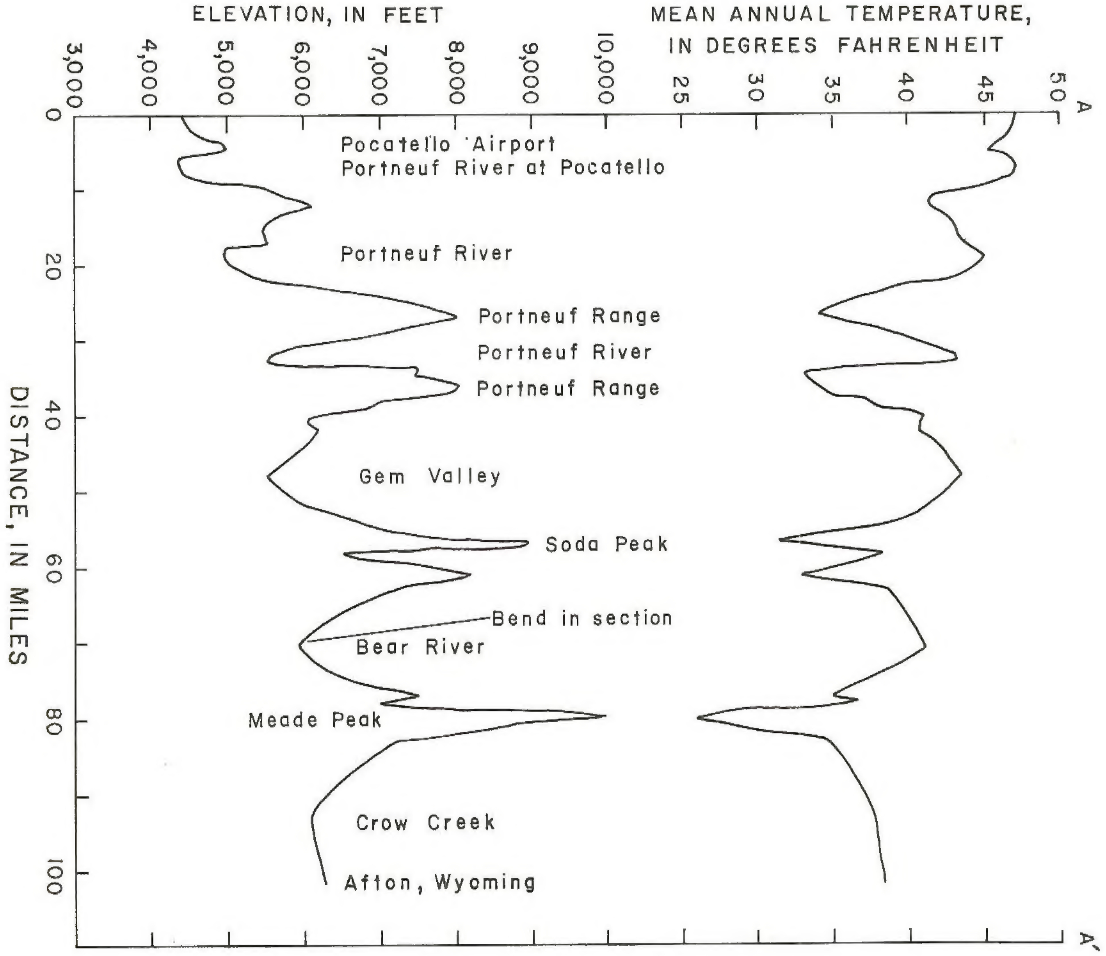

Figure 1-6.--Elevations and temperatures along line A-A' of figure 1-4.

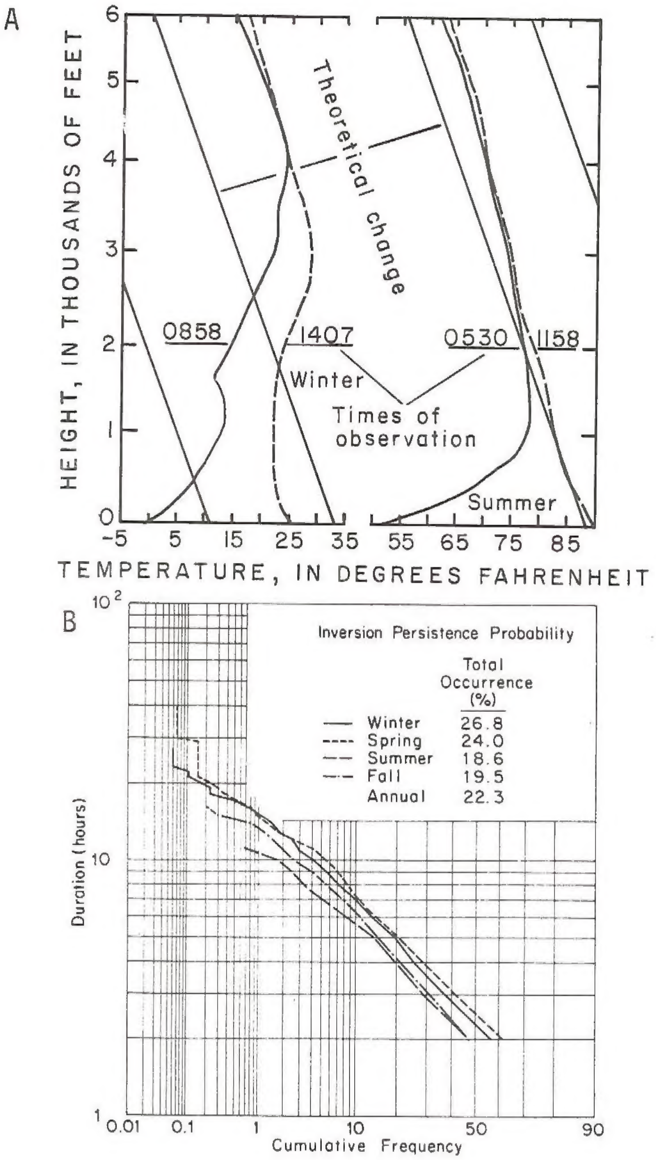

Figure 1- 7.--Temperature characteristics northwest of Pocatello. A, Typical variations of air temperature with elevations. B, Duration and frequency of inversions; example: the probability that an inversion will persist for at least 5 hours after becoming established is 20 percent. Adapted from data from Idaho National Engineering Laboratory.

The growing season (nonfreezing period) averages 142 days at Pocatello, 80 days at Montpelier, and less than 60 days at higher elevations in the area. Frost may occur anytime during the year above elevations of about 6,500 feet. Temperatures below freezing have occurred in every month at both Conda, Idaho, and Afton, Wyo.

Long-term records of wind movement are available for Pocatello airport, and they reflect air movement across the wide expanse of the Snake River Valley. Characteristics of wind in the study area are strongly affected by the local topography and vary considerably from place to place.

At Pocatello Airport, wind speeds are below 4 mph about 30 percent of the time; from 5 to 14 mph about 50 percent of the time; from 15 to 24 mph about 18 percent of the time; and 25 mph or more about 2 percent of the time. The higher velocities occur most frequently from December to April. The highest recorded average for 1 mile was 72 mph from the west, measured on March 24, 1955, with a momentary maximum of 81 mph.

Direction of the wind at Pocatello Airport corresponds roughly to the orientation of the nearby mountains. Well over 50 percent of the wind movement is from the southwest quadrant; about 20 percent from the southeast; and the remainder, about equally divided between the northeast and northwest.

Records of winds at high altitudes above the Idaho National Testing Laboratory show that above 10,000 feet, movements are almost exclusively from the western quadrants. These prevailing eastward flows of air are channeled by the valleys and mountain ranges. The variability of localized effects superimposed on the prevailing high winds makes determinations of wind patterns at specific points difficult, but the prevailing winds on the higher ridgetops in most of the mining area are from the west.

Relative humidity in the area is much lower in summer than in winter and in afternoons than in mornings, principally because relative humidity usually diminishes as temperatures rise. At Pocatello Airport, for example, relative humidity in July is below 30 percent about two-fifths of the time and below 50 percent about three-fourths of the time. In January, however, relative humidity is below 30 percent less than one two-hundredths of the time and below 50 percent only about one twenty-fifth of the time. Similarly, relative humidity is above 80 percent only about one thirty-fifth of the time in July but about one-half of the time in January. The mean relative humidity in July decreases from more than 50 percent before sunrise to less than 20 percent in midafternoon.

In general, temperatures decrease with altitude, and relative humidity should increase with elevation. On-site weather data at the Greiner Environmental Services are inadequate to define the relationship between relative humidity and elevation in the mining area.

Relative humidity, temperature, and wind influence evapotranspiration. Potential evapotranspiration is the water loss that would occur if there was never a deficiency of water in the soil for use by vegetation or for evaporation from the soil surface. Potential evapotranspiration and lake evaporation are practically equal under many conditions.

Because of the deficiency of water at times, actual evapotranspiration for nearly all crops and most vegetation in the study area is considerably less than lake evaporation would be. Potential evapotranspiration and precipitation for Pocatello Airport and a typical point at an 8,000-feet elevation are shown in figure 1-8. These two sites represent the highest and lowest precipitation in the area. At 8,000-feet, average potential evapotranspiration exceeds average precipitation during July, August, and September. At Pocatello Airport, average potential evapotranspiration exceeds average precipitation all months except November to February. During average months at lower elevations in the study area, a few inches of excess moisture are available in winter to recharge soil moisture or cause light runoff, but the soil moisture is soon exhausted in early spring by evapotranspiration.

The average additional water required from irrigation to sustain good yields of alfalfa, for example, is about 20 inches near Pocatello and 15 inches near Montpelier.

The difference between precipitation and the moisture requirements of vegetation is less at higher elevations, and more precipitation is available for runoff, usually as snowmelt. However, at some sites in the study area, soils become dry in August or September. The soils of the mountainous areas above 6,500 feet usually have sufficient moisture to supply evapotranspiration throughout the summer. At lower elevations, the soils may dry out in mid-summer or early fall.

Detailed data on sunshine, sky cover, and ceiling are available for Idaho Falls and Pocatello Airports, both of which are in the Snake River Plain. These kinds of visibility data are not available for points in the mountains of the study area, but percentages of possible sunshine and sky cover there are likely comparable to those at Pocatello and Idaho Falls. Low ceilings may, however, occur more often at higher elevations than on the Snake River Plain.

The percentage of possible sunshine at Pocatello Airport is high during warm months and low during cold months. Averages range from 84 percent in July to 37 percent in January.

The sky at Idaho Falls Airport is completely covered 62 percent of the time in January; 10 percent, in July. Sky cover at Pocatello Airport is a little more complete, ranging from 66 percent in January to 15 percent in July.

Ceiling heights greater than 5,000 feet occur at Idaho Falls and Pocatello Airports nearly 100 percent of the time in August and September, about 50 percent of the time in December. The ceiling is

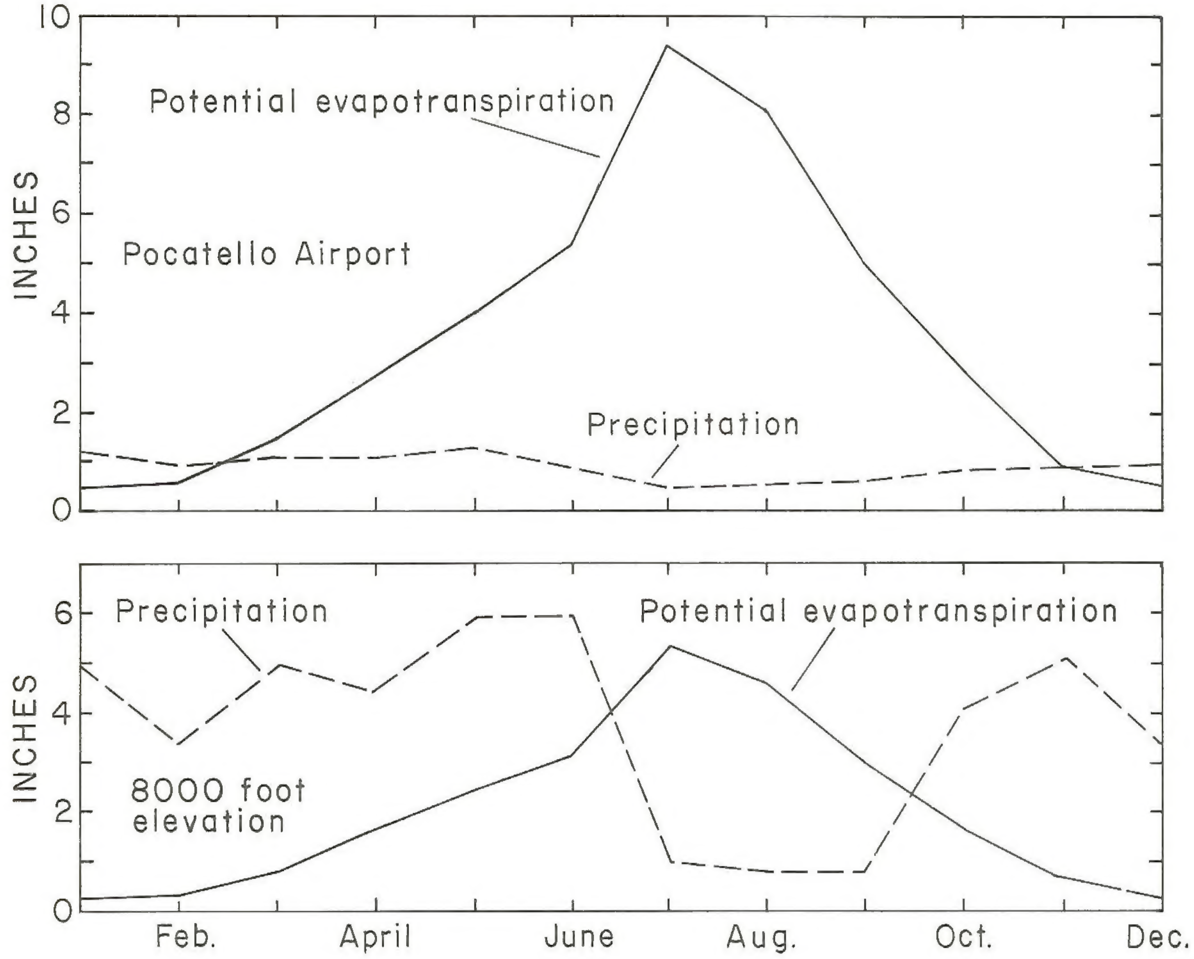

Figure 1- 8.--Precipitation and potential evapotranspiration at Pocatello Airport and at 8,000-foot elevation.

less than 300 feet about 4 percent of the time during night and morning hours. Ceilings are generally a little higher at Pocatello than at Idaho Falls.

There is small probability of tornado occurrence in the study area. Tornadoes reported by the National Weather Service in all of Idaho averaged less than two per year during the period 1956-73. Whirling winds or "dust devils" are more common and occur on warm, sunny days; many produce dust clouds several hundred yards in diameter, which extend several hundred yards into the air. Damage is usually minimal.

Thunderstorms are common and usually occur several days each month from June through August but are rare from November through February. Exposed trees and mountain peaks are often struck by lightning. Hailstorms and intense precipitation often accompany the thunderstorms. Hail damage and fires from lightning have been reported in the area.

At times, glaze icing from freezing rain and rime forms on the ground, roads, and exposed objects in the area. Blowing snow is common during the winter. Dust movement by wind occurs after earth surfaces are disturbed by vehicular traffic on dirt or graveled roads, construction, and summer fallowing of dry farms. Fogs usually occur only a few days per year. At times, visibility is seriously impaired by dust, drifting snow, fog, smog, or combinations of these. The intensity of impairment from fog or smog depends to a degree on the amount of dust and smoke already in the atmosphere.

2. LAND RESOURCES

a. Land Surface

The study area is characterized by north- and northwest-trending mountain ranges and valleys that form part of the Middle Rocky Mountains physiographic province. The valley occupied by Bear River and Bear Lake is the largest in the area and contains the principal transportation routes and the centers of business and population. At its north end, near Soda Springs, the valley continues northward across a low divide to the broad valley of the Blackfoot and Willow Creek Lava Fields; westward, it follows Bear River to Portneuf and Gem Valleys. The Snake River marks the northern boundary of the study area.

The entire area is over 4,500 feet high, the highest point being Meade Peak, about 7 miles east of Georgetown, which rises to an elevation of 9,957 feet. Sherman and Paris Peaks in the Bear River Range on the west side of Bear Lake Valley are, respectively, 9,669 feet and 9,572 feet high; Big Elk and Caribou Mountains in the Caribou Range near the northeast edge of the area, 9,476 feet and 9,803 feet. The relief between Meade Peak and Bear Lake Valley is about 4,000 feet. Local relief of 1,000 to 2,000 feet is common in the southern half of the area and in the Caribou Range, but it is generally less than 1,000 feet in the northwestern part, where the ranges are lower and where lavas and volcanic ash have partly filled the valleys.

The principal sources of information on regional physiography are Mansfield (1927), Mabey and Armstrong (1962), Cressman (1964), Armstrong (1969), and Mabey and Oriel (1970).

Folding of the rock layers early in the orogenic history of the area, and subsequent block faulting generally parallel to the fold axes, produced the linear trend of sharply defined valleys and ranges, features similar to those in the Basin and Range physiographic province to the southwest. Sediment, basalt, and ash partly filled some of the valleys as they developed. The thickness of sediments in Bear River valley south of Soda Springs is about 5,000 feet; in Gem and Portneuf Valleys, about 9,000 feet; and in Upper Valley, about 1,000 feet.

The present regional erosional stage is near maturity, as shown by broad valleys, meandering streams, and rounded topography. However, where basalts have flooded some valleys and interrupted the prevailing erosional regime, stream downcutting has been renewed.

b. Geology and Mineral Resources

The operating mines and most of the proposed mines are north and east of Soda Springs, on outcrops of the Meade Peak Phosphatic Shale Member of the Phosphoria Formation (map 1). These outcrops are the surface exposures of former blanket-type sediments that were deposited in a Permian sea 225 to 280 million years ago and were subsequently deeply covered by younger sediments and lithified. Later uplift, folding, faulting, and erosion of the rocks created the present outcrop pattern.

The chief sources of information about the regional geology are Mansfield (1927), Armstrong and Cressman (1963), Cressman (1964), Armstrong and Oriel (1965), and Mabey and Oriel (1970).

Map 3 is a geologic map of the main part of the study area. It includes a description of all the formations in the region except the Park City Formation of Permian age, which is represented only by its Grandeur and Franson Members.

The Phosphoria in much of the region is covered by younger rocks of Triassic, Jurassic, or Cretaceous age. Where rocks older than the Phosphoria are exposed at the surface, the formation has been removed by erosion or faulting. Because the study area is part of a large and complex thrust-fault belt, two important thrust-fault relationships are noted. One is where a thrust fault, such as the Paris thrust west of Ovid on the west side of Bear Lake Valley, has placed older rocks on top of the Phosphoria and other younger rocks. The other is where a thrust fault has placed the Phosphoria on top of younger rocks; for example, around Meade Peak, the Meade thrust moved parts of the Phosphoria and adjacent rock units over Jurassic and older rocks--including the Phosphoria--thereby causing the formation to occur twice in a vertical section. Other faulting produced additional complexities in the distribution of the Phosphoria, and many small-displacement faults can be seen in the phosphate mines.

The study area has many faults that are geologically young. These faults can be considered potentially active; that is, movement on any of them would not be surprising. Such movement would cause earthquakes, which would be felt most strongly near the fault. Breakage at the land surface would also be possible.

A belt of clustered earthquake epicenters (fig. 1-9) runs northward from the Wasatch front in Utah through the study region to the Yellowstone and Hebgen Lake regions in Wyoming and Montana. Soda Springs is in the belt, and Pocatello is west of it. The epicenters are less densely clustered here than elsewhere in the belt. Less than two dozen earthquakes capable of damaging structures have been reported in the study area from 1880, the earliest report, to 1970. In the next few decades, earthquakes will probably occur at a similar rate.

On the basis of historical earthquakes and the assumed locations of future earthquakes, there is less than 10 percent probability during the next 50 years of an earthquake of intensity VI or more near Pocatello, or of an earthquake of intensity VIII or more near Soda Springs. An earthquake of intensity VI would cause slight damage--a few instances of fallen plaster and damaged chimneys, and a few heavy objects, not fastened down, that would be moved. These effects would probably be confined to an area less than one-half mile across, and the earthquake would probably not be felt at all more than one mile away.

An earthquake of intensity VIII--the largest in the continental United States since the San Fernando, California, earthquake of February 1971--did occur on March 27, 1975 in Pocatello Valley (fig. 1-9). In general in the study area, an earthquake of intensity VIII or more would be expected less than once per 100 years. The Pocatello Valley quake was felt over 6,000 square miles. Malad City, 14 miles northeast of the epicenter, had $100,000 damage. If such an earthquake occurred in the study area, shaking near the epicenter could be expected to cause slight damage in structures built especially to withstand earthquakes; considerable damage and partial collapse in ordinary buildings, and great damage in poorly built structures. Masonry and concrete-block walls would crack and break. Chimneys, columns, and factory stacks and towers would twist and fall. Facilities such as storage bins would also be damaged. Landslides would occur on steep slopes and in wet ground, notably on free-flow dumps, especially if they were wet. Water flow from springs and wells would change. Pipelines and transportation facilities could be twisted or broken, especially if there was surface ground breakage. Some retention dams could fail.

Landslides or slumps, which are generally small, are common throughout the region. However, they are especially numerous, and many are large, at localities underlain by rocks of Cretaceous age in the northern part of the region.

In the study region, the Phosphoria Formation is made up of four members. The Meade Peak Phosphate Shale Member, which is the lowermost member, is overlain by the Rex Chert Member or the cherty

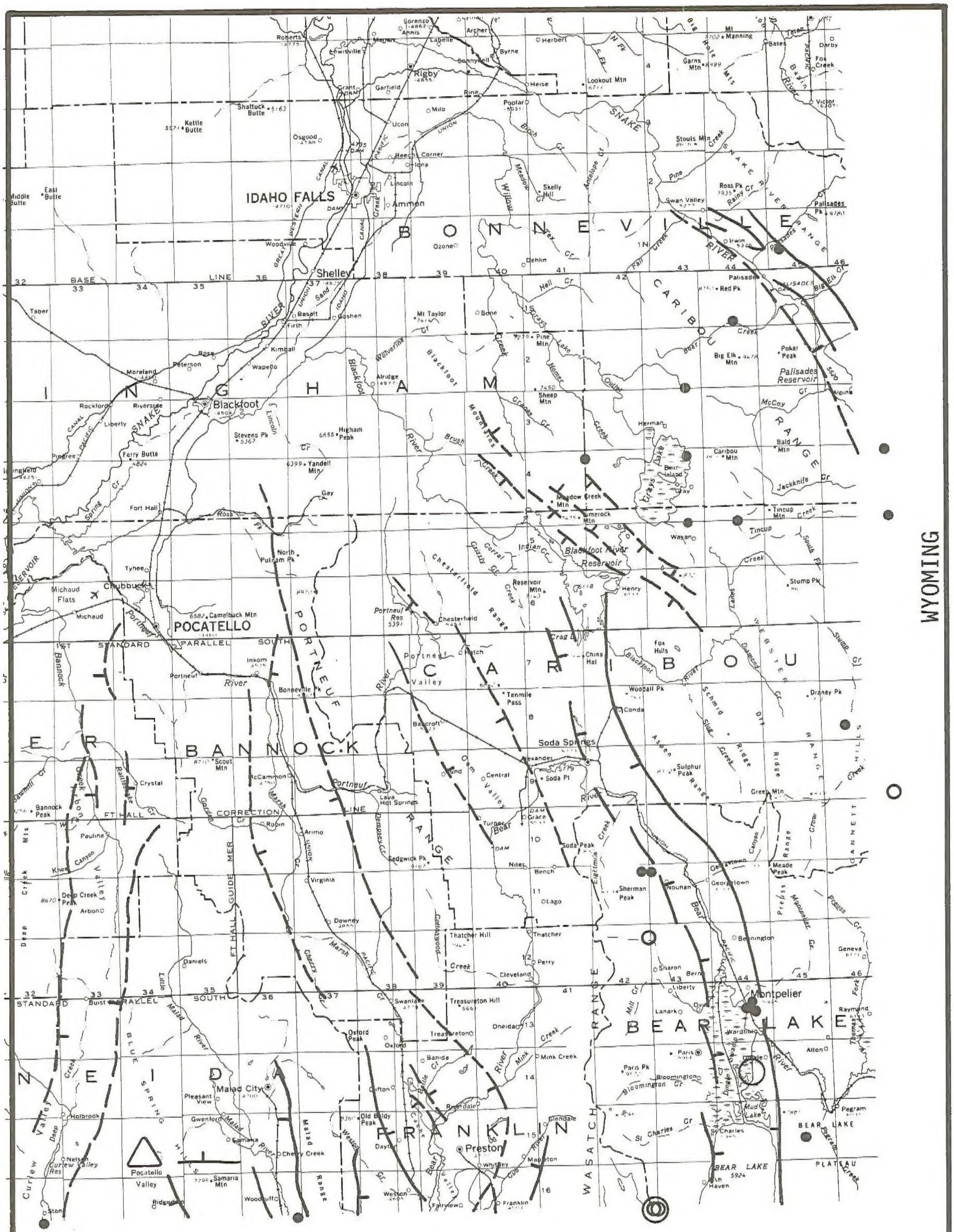

Figure 1- 9.--Epicenters for earthquakes from 1880 to 1970 and for the Pocatello Valley earthquake of March 27, 1975: closed circles, earthquakes of intensity V; four small open circles, intensity VI; two large circles, intensity VII; triangle, intensity VIII. Potentially active faults: solid lines, younger than 90,000 years; dashed lines, younger than 20 million years.

shale member. The Retort Phosphate Shale Member occurs in the northern and eastern parts of the region where it is the top member of the Phosphoria. The Meade Peak is underlain by the Grandeur Tongue of the Park City Formation, which also is of Permian age.

Small amounts of phosphate rock occur in the Retort Member, as well as in some rock units of Ordovician, Mississippian, and Pennsylvanian ages, but all of the significant phosphate resources of the region are in the Meade Peak Member.

The Meade Peak ranges in thickness from about 55 feet at the north end of the Blackfoot Mountains to around 200 feet in the central part of the region.

The principal rock types are phosphate rock (phosphorite), carbonate rock, mudstone, and some chert. They are black and hard when fresh but weather to grays and browns, and many become soft owing to the loss of carbonate minerals, organic matter, and pyrite. Phosphate rocks are typically pelletal in texture. A thin bioclastic phosphate-rock layer occurs at the base of the Meade Peak throughout the area. Carbonate rocks are generally fine grained, although some dolomites are sandy in texture.

One mineral or a characteristic combination of minerals usually dominates the principal rock types: phosphate rock is composed mostly of carbonate fluorapatite; carbonate rock, of calcite and dolomite; mudstone, of quartz, feldspar, muscovite, clay minerals, iron oxide minerals, and pyrite; and chert, of microcrystalline quartz. However, particular mineral occurrences are not restricted to a specific rock type, and the wide ranges of mineral proportions that occur produce many intermediate rock types, such as carbonatic phosphate rock and phosphatic mudstone.

Chemical analyses of phosphate rock, carbonate rock, and mudstone in the Meade Peak in the study area are shown in table 1-5; the amounts of P_2O_5, CO_2, and SiO_2 clearly reflect the dominant minerals in the respective rock types.

Phosphate in the Meade Peak is concentrated principally in an upper zone and a lower zone, as shown in the columnar section in figure 1-10. These are the major ore zones that are mined, and they range in total thickness from about 30 to 60 feet. The thickness mined at any locality is determined by regional and local variations of phosphate content and by the grade requirements for specific mill and plant processes. The rock between the ore zones constitutes waste rock, which is used to fill mined-out areas or is dumped in areas adjacent to the mines.

The grade of phosphate rock depends on the amount of other minerals and organic matter in the rock and on the amount of carbonate (CO_3) that substitutes, in carbonate fluorapatitie, for phosphate (PO_4); the higher the carbonate, the lower the grade. The amount of carbonate

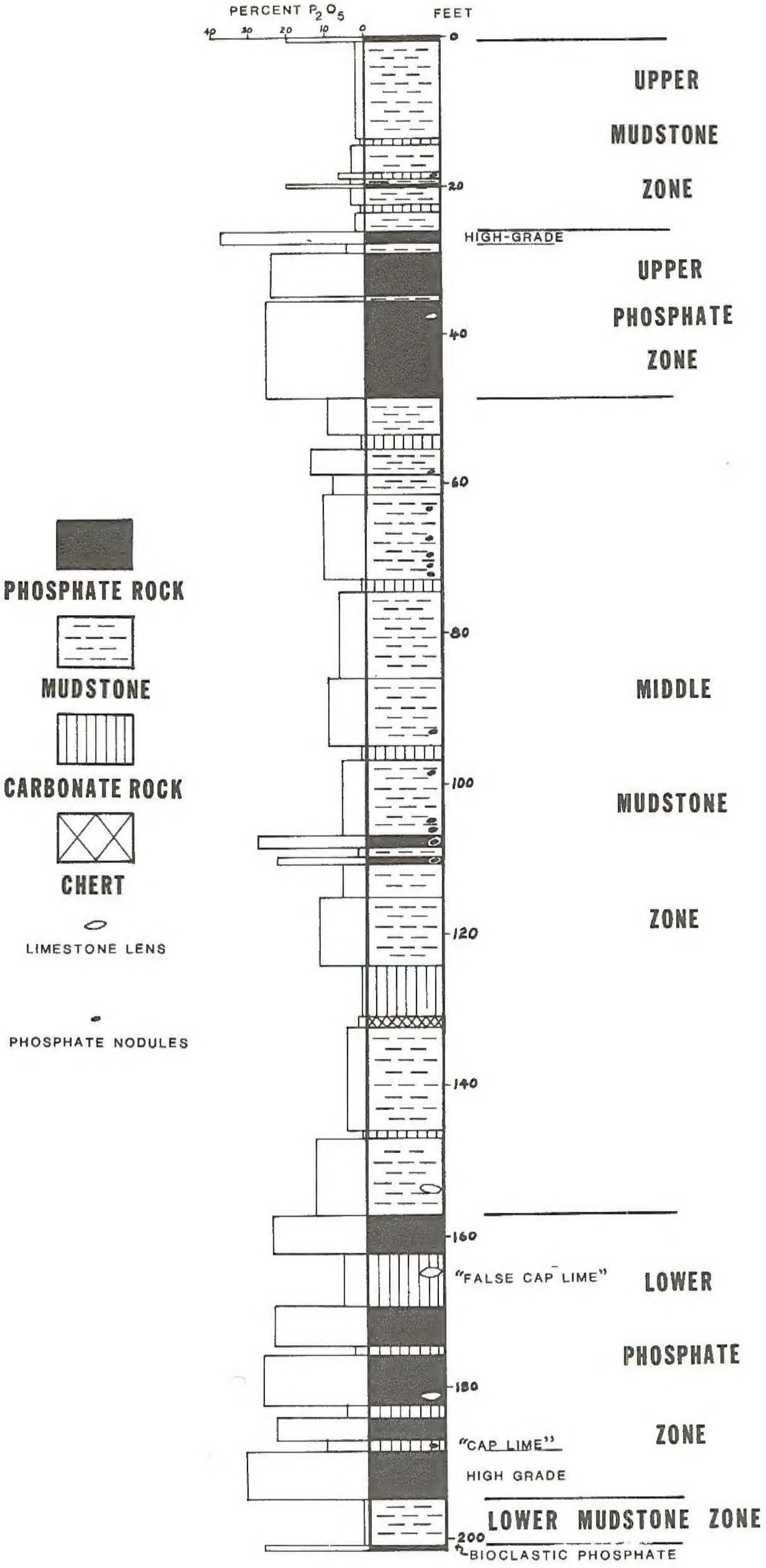

Figure 1-10.--Section of the Meade Peak Phosphatic Shale Member of the Phosphoria Formation at Maybe Canyon. From McKelvey and others (1952).

Table 1-5.--Chemical composition, in average weight percent, of the major rock types of the Meade Peak Phosphatic Shale Member in southeastern Idaho (Data from Gulbrandsen, 1966; 1975)

Constituent	Phosphate rock[1]	Carbonate rock[2]	Mudstone[3]
SiO_2	9.3	11.8	68.3
Al_2O_3	1.6	2.5	11.1
Fe_2O_3 4/	1.0	.8	4.0
FeO	--	.2	.4
MgO	.3	12.7	.6
CaO	45.6	30.3	3.1
Na_2O	.6	.3	1.2
K_2O	.4	.6	2.7
H_2O^{tot} 5/	2.4	1.4	3.4
H_2O^-	.7	.4	1.0
TiO_2	.1	.1	.8
P_2O_5	31.6	2.9	2.0
CO_2	2.1	34.4	.2
SO_3	1.8	.3	.3
F	3.2	.3	.3
Organic matter 6/	2.7	1.9	2.3
Oil	.1	.1	.2
Total 7/	102.7	100.3	100.3
Adjusted total 8/	101.3	100.2	100.2

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[1] 18 analyses for all constituents, except 6 analyses for SO_3.
[2] 6 analyses for all constituents, except 4 analyses for SO_3.
[3] 6 analyses for all constituents, except 3 analyses for SO_3.
[4] Total iron as Fe_2O_3.
[5] Total H_2O. Includes H_2O from combustion of organic matter and possibly some F from recystallization and decomposition of carbonate fluorapatite.
[6] Loss of weight, in percent, between 230° and 500° C.
[7] Excludes FeO, H_2O^-, and oil.
[8] Total, less $O=F_2$.

substitution tends to be low in the main part of the study region, averaging about 1.7 percent as CO_2 and thereby enabling a theoretical maximum content in carbonate fluorapatite of about 39.5 percent P_2O_5 as compared to a maximum in theoretical fluorapatite of 42.2 percent P_2O_5.

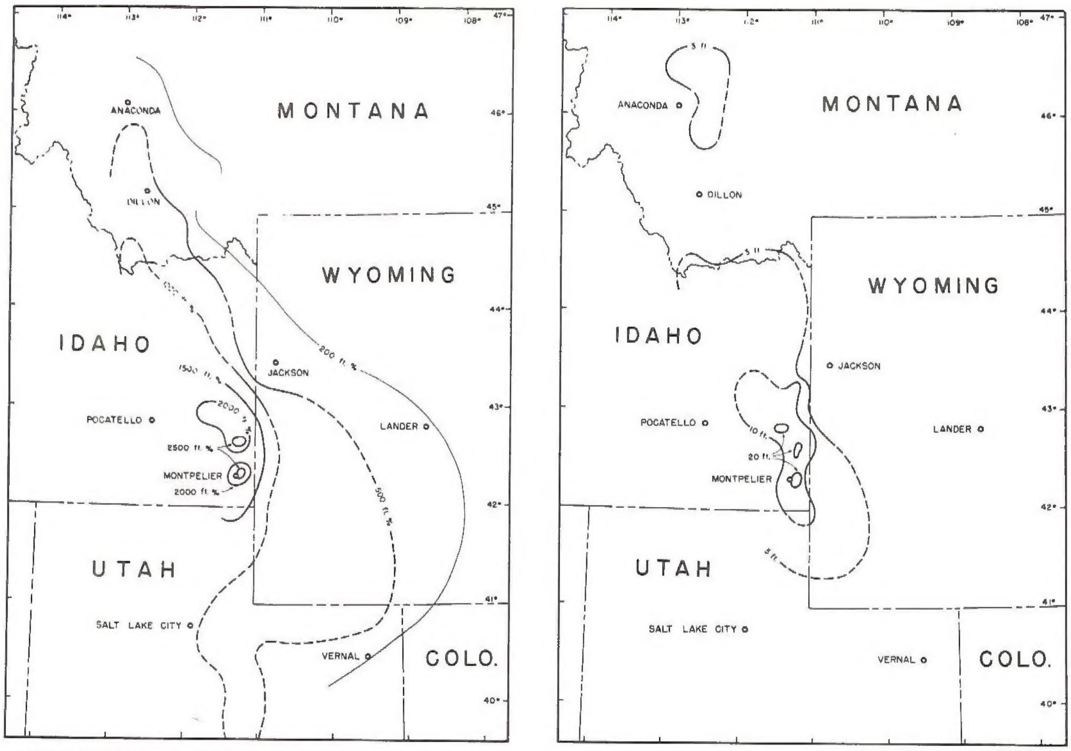
Weathering (alteration) by solution and oxidation on and near the Earth's surface, reduces the amount of calcite, dolomite, and organic matter in phosphate rock. The depth of weathering varies, depending on many geologic factors, but is known to be hundreds of feet in many places. The grade of rock increases with increased weathering, often by as much as several percent P_2O_5.

Figure 1-11 shows the distribution in the western phosphate field of the total phosphate as well as the total thicknesses of rocks that contain more than 31 percent P_2O_5, 25 percent P_2O_5, and 18 percent P_2O_5. The arcuate highs trending through the central part of the study region show that it contains the greatest concentration and greatest ore-grade thickness of phosphate in the field.

The present reserves of phosphate in the area comprise that part of the total known phosphate resources that can be recovered economically at the present time; however, changes in technological, political, and consumptive factors can quickly alter the amount of the reserves. McKelvey (1973) discusses in detail the definition and classification of reserves and resources.

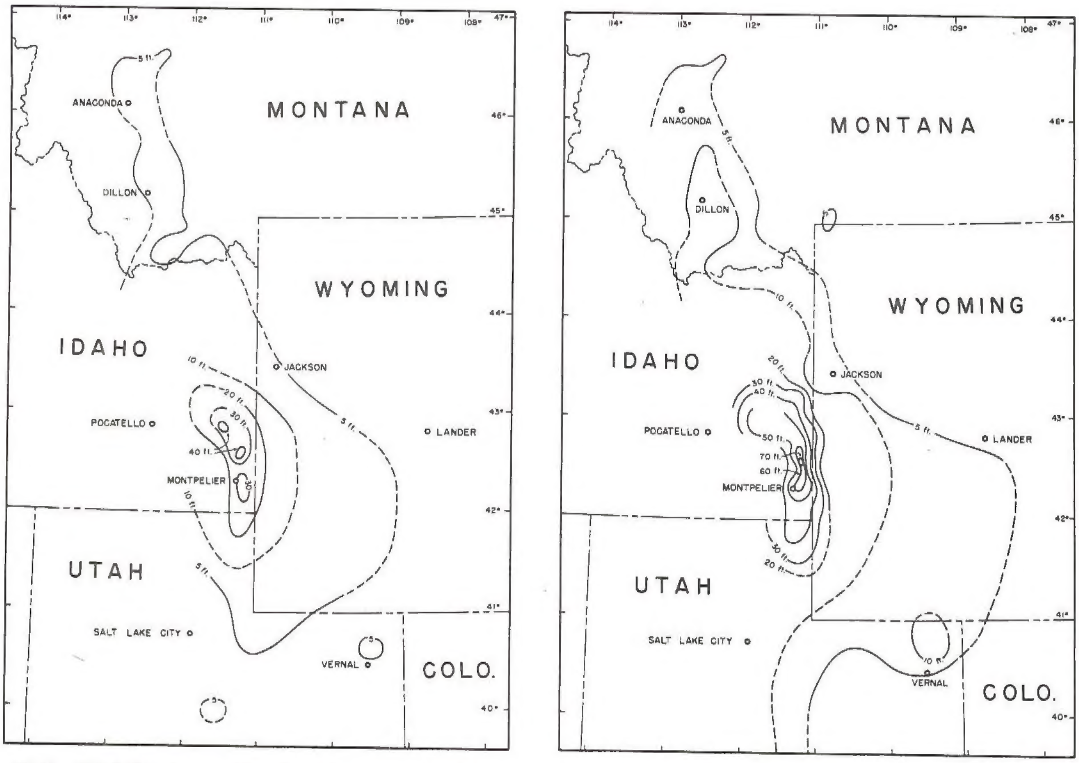
The grade of phosphate rock is expressed in percent P_2O_5, and rock equaling or exceeding 24 percent P_2O_5 is currently considered to be ore grade. Within this context, the area contains about 1 billion short tons of phosphate reserves, under present economic conditions (table 1-6).

The reserves estimated in 1974 by the mining engineer, L. J. Garrand, for the U.S. Forest Service were for the most, but not all, of the study region; because they are the most detailed calculations available, they form the basis for the estimate made here of the reserves in the whole study region. Powell estimated the reserves for most of Idaho, but they included only those to an average downdip mining depth of 250 feet, about one-half of the depth considered by Garrand; consequently, Powell's estimate is correspondingly lower.



TOTAL PHOSPHATE IN PHOSPHATIC PORTIONS OF FORMATIONS EXPRESSED IN FEET TIMES PERCENT P_2O_5

TOTAL THICKNESS OF 31 PERCENT P_2O_5 ROCK (IN FEET)



TOTAL THICKNESS OF 25 PERCENT P_2O_5 ROCK (IN FEET)

TOTAL THICKNESS OF 18 PERCENT P_2O_5 ROCK (IN FEET)

Figure 1-11.--Distribution and quality of phosphate in the Phosphoria and Park City Formations. From Swanson and others (1953).

0 100 200 MILES

Table 1-6.--Estimated reserves and resources of phosphate in all or parts of Idaho

Source	Million short tons	Million metric tons
RESERVES OF PHOSPHATE ROCK		
Service (1966)[1]	498	450
Lewis (1970)[2]	1,340	1,200
Powell (1974)[3]	451	410
Garrand (unpublished data, U.S. Forest Service contract, 1974)[4]	850	770
Estimate for study region (unpublished data, Gulbrandsen, U.S. Geological Survey, 1975[5]	1,000	910
RESOURCES OF PHOSPHATE OF VARIOUS GRADES[6]		
Service (1966). Resources above and down to. 100 feet below entry level.		
Grade of rock:		
31% P_2O_5	1,046	950
24% P_2O_5	2,518	2,300
18% P_2O_5	4,011	3,600
10% P_2O_5	5,988	5,400
Lewis (1970). Grade of rock		
25% P_2O_5	6,700	6,100

Table 1-6.--Estimated reserves and resources of phosphate in all or parts of Idaho--Continued

Source	Million short tons	Million metric tons
RESOURCES OF PHOSPHATE OF VARIOUS GRADES[6]--Continued		
Garrand (unpublished data, U.S. Forest Service contract, 1974).		
Resources[7] for open-pit mining with:		
Stripping ratio of 9:1, maximum high-wall slope of 40°, and grade of rock of about 27% P_2O_5	1,395	1,260
Same stripping ratio and high-wall slope as above but with grade of rock 17.2% P_2O_5	1,895	1,720
Gulbrandsen (unpublished data, 1976).		
Grade of rock:		
more than 20% P_2O_5	77,000	70,000

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[1] Most of Idaho. Grade of rock 24% P_2O_5.

[2] All of Idaho. Termed "marketable rock," which includes beneficiated rock and unbeneficiated "mined rock." Grade of rock 25% P_2O_5.

[3] Most of Idaho. Grade of rock 25% P_2O_5. Open-pit mining; average downdip depth 250 feet.

[4] Main part of study area within or near Caribou National Forest. Grade of rock 26% P_2O_5. Average downdip depth 520 feet. Stripping ratio 3.5:1.

[5] Garrand's estimate for main part of region plus an estimate for the principal part of the region that is not treated by Garrand (see Chesterfield-Reservoir Mountain permit areas of Part 2) Grade of rock 24% P_2O_5.

[6] In same areas as reserves.

[7] Cumulative figures--include reserves.

Phosphate resources can be classified according to the economic feasibility of mining and the extent to which geologic conditions are known; resources are usually classed by grade, depth of burial, and stripping ratio. Resources estimates from the same sources as the reserves estimates, except Powell, are also shown in Table 1-6. Service's estimate of 2,518 million short tons of ore-grade rock in most of the State includes resources at depths likely to be considered for underground mining; his resources estimate is about five times greater than his reserves estimate. Garrand's conservative estimate of 1,395 million short tons of ore-grade resources is based largely on a higher stripping ratio than is used for current open-pit mining. Lewis' estimate of ore-grade resources in the entire state, although encompassing a larger area, is significantly higher than all estimates other than Gulbrandsen's. The latter's estimate of the total amount of ore-grade rock, mostly deeply buried, in the Meade Peak of the study region, provides perspective for judging the full potential of the phosphate resources.

A number of significant minerals and elements occur in the phosphate rock.

Fluorine occurs in carbonate fluorapatite at an F-to-P_2O_5 percentage ratio of about 0.1, so ore-grade rock averages about 2.4 percent fluorine. The amount of fluorine in the 1 billion short tons of phosphate-rock reserves of the Meade Peak, therefore, equals or exceeds 24 million short tons. Although a large potential resource, fluorine is not presently produced from phosphate rock in the western field. Alumet, however, plans to recover a fluorine product in the form of cryolite (aluminum fluoride) at its Utah processing plant for use in the aluminum reduction plant of National Southwire Aluminum Co., in Hawesville, Kentucky.

In Meade Peak phosphate rock, vanadium averages about 800 ppm and is currently recovered by Kerr-McGee as a byproduct of Monsanto's and FMC's electric-furnace production of elemental phosphorus. In mudstone, it averages about 700 ppm, and, according to Earth Sciences, Inc., an approximately 11-feet-thick vanadium-rich zone in Bloomington Canyon contains an average of about 4,600 ppm (0.46 percent) vanadium, in association with pyrite, organic matter, and many other rare elements. Earth Sciences plans to recover vanadium contained in this zone. The amount of vanadium in the phosphate-rock reserves of the Meade Peak is about 0.8 million short tons. The amount of vanadium resources and recoverable vanadium in the vanadiferous zone in the region is large but is not presently known.

Uranium occurs in significant amounts in the Meade Peak, averaging 90 ppm in the phosphate rock and about 110 ppm in ore-grade rock. On this basis, 0.11 million short tons of uranium are contained in the 1 billion short tons of phosphate-rock reserves. None is now recovered, but it might be in the future since plans are currently underway to extract uranium from the phosphate in Florida. Alumet presently plans to recover byproduct uranium in the form of yellow cake

(U_3O_8) during the phosphate acidulation process at its Milford, Utah plant site.

The rare-earth elements (lanthanons plus yttrium) occur in carbonate fluorapatite as replacements of calcium. As a group, they average about 1,000 ppm in phosphate rock, which amounts to 1 million short tons of rare earths in the Meade Peak phosphate-rock reserves. Altschuler and others (1967) estimated that byproduct recovery of rare earths from the phosphate produced annually in the Nation would equal the amount produced from other sources. At present, however, such byproduct recovery is not considered economically feasible.

The extent to which average abundances of many rare elements in the Meade Peak exceed those in the Earth's continental crust is demonstrated in table 1-7. In all rock types of the Meade Peak, concentrations of selenium and cadmium are 200 or more times greater than they are in the crust.

In the vanadiferous zone at Bloomington Canyon (table 1-8), the average concentrations of selenium and cadmium are, respectively, 560 ppm and 470 ppm; the concentration factors, 11,000 and 2,350. (The concentration factor is the average concentration of an element in the vanadiferous zone, divided by its average concentration in the continental crust; it indicates quantitatively how much more abundant the element is in the zone than it is in the crust.) Although both elements in the vanadiferous zone constitute significant resources, selenium is more important and Earth Sciences plans to recover it as a byproduct.

If and when the technology is developed and the ore tenor and processing economics become favorable, then the above-noted trace elements will be recovered as byproducts on a more widespread basis. In the interim, most phosphate producers will stockpile products containing significant byproduct values.

Table 1-7--Estimated abundances of rare elements, in parts per million, in rocks of the Meade Peak Phosphatic Shale Member, southeastern Idaho, and in the continental crust. Average values (Av.) precede maximum values (Max.) in parentheses. (Data compiled by U.S. Geological Survey)

	Phosphate rock		Carbonate rock		Mudstone		
Element	No. of Samples	Av.(Max.)	No. of Samples	Av.(Max.)	No. of Samples	Av.(Max.)	Continental crust
Antimony	96	6(20)	12	9(30)	78	8(30)	0.2
Arsenic	96	30(200)	12	25(40)	78	26(60)	1.8
Barium	66	100(300)	25	60(200)	19	300(1,000)	425
Beryllium	66	~1(3)	25	--(1.5)	20	~1(4)	2.8
Boron	66	~10(100)	25	--(30)	19	100(300)	10
Cadmium	67	90(800)	17	40(150)	20	50(1,000)	.2
Cerium	66	--(300)	17	--(200)	1	--(100)	60
Chlorine	3	300(300)	2	300(300)	1	400(400)	130
Chromium	66	800(3,000)	25	350(1,000)	19	850(3,000)	100
Cobalt	144	6(20)	6	6(10)	72	8(30)	25
Copper	145	85(400)	31	30(150)	91	70(500)	55
Dysprosium	48	--(100)	1	--(100)	1	--(20)	3
Gadolinium	66	60(150)	19	20(70)	1	--(25)	5.4
Gallium	66	<2(10)	19	<2(10)	19	9(15)	15
Germanium	48	<7 --	19	<7 --	13	<7 --	1.5
Holmium	48	--(30)	1	--(20)	--	-- --	1.2
Iodine	2	2(4)	--	-- --	--	-- --	.5
Lanthanum	66	250(1,000)	19	100(700)	19	45(300)	30
Lead	66	6(20)	25	--(10)	19	10(30)	12.5
Lithium	48	<200 --	19	<200 --	13	<200 --	20
Manganese	144	45(600)	31	85(150)	91	150(1,800)	950
Mercury	26	.5(1.3)	2	.4(.5)	19	.5(1.6)	.08
Molybdenum	144	30(300)	31	25(100)	92	30(300)	1.5
Neodymium	66	150(1,000)	19	60(500)	13	95(300)	28
Nickel	144	100(1,000)	31	85(300)	91	150(500)	75
Niobium	48	<7 --	19	<7 --	13	<7(10)	20
Rhenium	4	<10	--	-- --	6	<10(11)	?
Samarium	48	--(200)	--	-- --	1	--(7.5)	6
Scandium	66	8(30)	25	4(15)	20	9(20)	22
Selenium	62	30(800)	6	40(50)	17	14(1,500)	.05
Silver	123	5(30)	30	2(10)	91	4(20)	.07
Strontium	66	1,000(3,000)	25	450(2,000)	19	250(1,000)	375
Thallium	14	3(35)	2	2(4)	19	5(130)	.45
Thorium	3	~10(26)	--	-- --	--	-- --	9.6
Tin	49	7(100)	19	<7 --	14	<7(30)	2
Uranium	833	90(400)	182	20(100)	889	30(200)	2.7
Vanadium	265	800(17,000)	59	300(2,000)	266	700(4,000)	135
Ytterbium	66	15(70)	25	5(30)	19	7(20)	3
Yttrium	66	500(1,500)	25	100(1,000)	19	90(500)	33
Zinc	67	250(4,000)	23	200(1,500)	19	300(10,000)	70
Zirconium	67	40(200)	25	25(100)	19	250(500)	165

Table 1-8.--Estimates of selected rare element abundances in the vanadiferous zone at Bloomington Canyon and concentration factors, in parts per million (ppm). Data compiled by U.S. Geological Survey

Element	Vanadiferous zone			Continental Crust	Concentration factor
	No. of Samples	Average	Maximum	Average	
Arsenic	10	30	50	1.8	17
Boron	10	130	200	10	13
Cadmium	10	470	980	0.2	2,350
Chromium	10	1,200	1,600	100	12
Mercury	10	1	1.6	0.08	12.5
Molybdenum	10	60	280	1.5	40
Selenium	10	560	1,200	0.05	11,000
Silver	10	16	20	0.07	230
Thallium	10	40	110	0.45	89
Tin	10	40	100	2	20
Vanadium	10	4,600	17,000	135	34
Zinc	10	2,400	10,000	70	34

In all rock types of the Meade Peak, concentrations of antimony, arsenic, molybdenum, and silver are more than 10 times greater than those in the crust. Because silver in the vanadiferous zone averages 16 ppm, a concentration factor of 230, Earth Sciences plans to recover it as a byproduct.

Thallium, chromium, and mercury are moderately concentrated in phosphate rock and mudstone. Thallium, however, is highly concentrated in the vanadiferous zone, averaging 40 ppm--a concentration factor of 89--and if it can be recovered, it will become a large and important part of the total U.S. reserves.

Zinc and tin are concentrated in the vanadiferous zone by factors of 34 and 20, respectively. The concentration of zinc averages 2,400 ppm, so this element may also be recovered as a byproduct by Earth Sciences. The tin content is high for sedimentary rocks but not high enough to constitute an important resource at this time.

Many rare elements are associated and concentrated together. They correlate in a general way with organic matter, and some occur as sulfides.

Oil shale in the Meade Peak has been reported only in the Paris-Bloomington area, where it occurs in the vanadiferous zone; the yields of oil range from 6 to 10 gallons per tons of rock (McKelvey, 1946). The oil content of the major rock types in the entire Meade Peak of the area, as noted in table 1-5, is low--about 0.1 to 0.2 percent.

On the basis of the recent discovery of the ammonium feldspar buddingtonite (Gulbrandsen, 1974), as much as 3 percent ammonium occurs in the Meade Peak as $(NH_4)_2O$. The presently known distribution of buddingtonite indicates that small amounts of ammonium may be present in much of the member in most of the area. In the Meade Peak, total nitrogen, in all forms of its occurrence, averages about 0.4 percent and ranges from 0.1 to 2.4 percent; in the vanadiferous zone at Bloomington Canyon, it averages 1.3 percent (Gulbrandsen, 1975).

Thermal springs are widely scattered in southeastern Idaho. Chemical and geophysical analyses have been conducted on at least 5 springs or wells within the subject area (Young and Mitchell, 1973). Their characteristics are shown in the following table.

Spring or Well I.D. number and location	County	Discharge gpm	Surface Temp. °C	Date	Aquifer Temp. °C from Geochemical Thermometer	
					Silica	Na-K-Ca
Bear Lake Hot Springs 15S,44E, 13 cca 1S	Bear Lake	--	47.5	5/9/72	85	230
1N, 43E, 9 cbb 1S	Bonneville	70	25.0	8/10/72	35	190
6S, 41E, 19 baa 1S	Caribou	1,300	42.0	8/15/72	70	370
Soda Springs 12 add 1S	Caribou	--	31.0	8/15/72	80	35
Heise Hot Springs 4N, 40E, 25 dcb 1S	Jefferson	60	49.0	7/27/72	80	205

According to the U.S. Geological Survey, there are lands in the area that could be prospected for geothermal resources. These lands area considered potentially valuable for geothermal exploration. The majority of lands in southeastern Idaho are also considered potentially valuable for oil and gas exploration. About 303,000 acres of Federal land are currently under lease, and lease applications have been filed for 155,000 additional acres. Although 11 exploration wells have been drilled in the area no resources of oil or gas have been discovered.

Information about the area's mineral resources in rocks other than the Phosphoria is taken from Mansfield (1927), Vine and Moore (1952), and Savage (1961).

Oil shale, other than that described in the Phosphoria, has been discovered only on the bank of Bear River about 4 miles south of Soda Springs, where a flat-lying bed over 4 feet thick disappears under basalt; a sample of the bed yielded 20 gallons of oil per ton of rock.

Coal occurs in the Bear River Formation of Cretaceous age in the Fall Creek area of the Caribou Range, where a 4-foot interval contains interbedded coal, clay, and limestone. Coal beds also crop out at other localities. The coal is considered too poor in quality and its beds too thin to be of present economic value.

Five mining districts are located within the study area. The mining districts are: the Bear Lake lead and copper district, the Montpelier copper district, and the Nounan copper district in Bear Lake County; the Mount Pisgah gold district in Bonneville County; and the Willow Creek-Caribou coal district in Bingham and Bonneville Counties. Of the five districts only the Mount Pisgah district in T. 4 S., R. 44 E. had any significant production. Much gold was taken from placers in the Caribou (Pisgah, Bainbridge) Mountain area in the late 1800's, and activity has continued sporadically until recent times. Currently there is some prospecting and exploration activity in the area. Occurrences of lode and placer deposits have been reported in other parts of the EIS area, but the amounts are not significant.

Abundant resources of carbonate rock occur in formations ranging in age from Cambrian to Quaternary. The Monroe Canyon Limestone of Mississippian age is quarried on the north side of Trail Canyon, a few miles east of Soda Springs.

The Swan Peak Quartzite of Ordovician age, an immense silica resource, is quarried about 2 miles north of Soda Springs. This formation is widely distributed in the Soda Springs hills north of the city and the southern part of the Bear River Range. Other quartz-rich sedimentary rocks are abundant throughout the area, particularly in the Paleozoic rocks, and augment the silica resources. Road metal, sand and gravel, and building stone are produced from abundant carbonate rock, quartzite, sandstone, chert, basalt, tuff, travertine, and alluvial deposits.

Pumice is widely distributed around Ammon, in the northwestern part of the area, but only small amounts have been mined from beds ranging from at least 60 to 80 feet thick.

Between 1906 and 1925, more than 1,000 short tons of salt were produced from salt deposits along Crow Creek and Stump Creek, near the eastern edge of the area. Production was from saline spring deposits but more recent local oil-exploration drilling revealed that the salt in the springs actually comes from the thick beds in the lower part of the Preuss Sandstone of Jurassic age. Salt deposits formed from the saline springs are not large enough to be economically significant.

The only uranium in the area, besides that in the Phosphoria, occurs in the coal and carbonaceous rocks of the Bear River Formation. In the Fall Creek area, the average uranium content is as high as 0.11 percent; in the top 1 foot of the coal, about 0.045 percent. No uranium production is known.

Small deposits of sulfur, formed from sulfur springs, are located southeast of Soda Springs along the western front of the Aspen Range. Some of these deposits were mined for sulfur in the late 1890's and the early part of the 1900's, but the resource does not appear to be large.

Alluvial clay deposits near Ammon and Bone are used for making bricks. Gypsum, bentonite, and perlite also occur in the area, but no production is known.

c. Soils

Forest-land soils of the study area have developed under a subhumid forest canopy that is common in mountainous land of the Middle Rocky Mountains. Owing to the subhumid climate and the types of vegetation, organic matter accumulates rapidly, and soil surface horizons are thick and dark colored; subsoil colors are usually lighter. Nearly all upland forest soils are residual and have developed in place from weathered sedimentary bedrock--mostly limestone, sandstone, chert, and phosphatic shale. To some degree, developed soils reflect the character and kind of bedrock: Stony to gravelly loam and medium-textured soils are underlain by Jurassic and Triassic limestone, sandstone, and chert; finer-textured soils, by Cretaceous limestone, sandstone, shale, and some conglomerate.

On gentle mountain slopes, the slightly altered bedrock is usually not more than 36 inches below the surface; on steep slopes, from 12 to 36 inches; and on extremely steep slopes, only a few inches. Rock outcrops are common throughout most mountainous land.

The fine-textured soils on gentle slopes usually have moderately well developed clay subsoils. On very steep slopes, there is little or no soil because erosion occurs faster than soil can develop. The subsoils of medium-textured stony soils are only weakly to moderately developed, and their texture is nearly the same as that of the surface soil horizons.

Soils on foothills and valley bottoms consist of a loess cap deposited over sedimentary or basaltic bedrock and water-transported alluvium. They have somewhat lighter surface colors and are usually more than 10 feet deep over solid bedrock.

Some alluvial soils occur in small, very narrow, elongated, continuous or broken strips along most of the main drainages within the mountainous portions of the area. They developed from varied materials washed from the uplands and higher elevations. The soils have organic surface layers. High water tables are common in and near the floodplains.

Soil reaction varies from slightly acid to slightly alkaline. A few soils at extremely low elevations have secondary accumulations of lime in the lower subsoils. Areas with rock outcrops and associated shallow soils less than 20 inches deep, occur mainly as steep escarpments and are fairly extensive throughout mountainous land. These shallow soils have very thin surface horizons, are weakly developed, and contain large amounts (over 35 percent by volume) of coarse fragments throughout their profiles.

Soil descriptions adopted for this study are based on the land systems inventory developed by the Forest Service. In this system, landtype associations represent the broadest level of combining elements of soils, landforms, and vegetation. Criteria for identifying landtype associations are determined by the dominant elements of the ecological systems operating throughout the entire unit. The criteria selected are those that can be visibly identified on maps, on aerial photographs, or on the ground; they generally reflect the geomorphic processes responsible for shaping the topography, but they may also include vegetative patterns or soil-development sequences.

The distribution of landtype associations in the study area is shown in Map 4; their characteristics are described in detail later in this section; and the interpreted characteristics of soils in the landtype associations are presented in table 1-9. The soils families included in each landtype association are listed in table 1-10.

Management problems associated with soils on mountainous portions of the study area are related strongly to the climate and geologic parent materials. Cold temperatures and short growing seasons slow soil formation almost to a standstill. Although the mountains receive considerable precipitation, most of it is unusable, as very little comes during the growing season. This fact directly influences the reestablishment of vegetation and, to a lesser extent, soil erosion. Erosion potential is significantly increased if vegetation is removed and surface soils disturbed. Fine-textured soils are easily compacted, may shrink when dry, and have poor bearing strengths when wet. Fine textures, slow permeability rates, soil saturation, and steep slopes

Table 1-9 .--Interpreted characteristics of soils in landtype associations in study area

Landtype association	Parent material (depth to bedrock, in inches)	Slope range, in percent	Available water, in inches[1]	Permeability	Erosion potential	Hydrologic group	Revegetation potential	Mass movement and slumping potential
1	Alluvium (>60)	2-15	7.0-10.5	Slow	Moderate to low	C-D	Very high	Very low.
2	Permian-Triassic limestone, sandstone, chert, and shale (24-48)	35-55	3.5-6.0	Moderate	Moderate to high	B-C	Moderate	Low.
3	Permian-Triassic limestone, chert, and shale (24-60)	25-45	5.0-7.0	High to moderate	Moderate	B	Moderate to high	Low.
4	Carboniferous shale, limestone, and sandstone (40-60)	35-55	7.5-10.5	Slow	Moderate to high	D	Low to very low	Moderate.
5	Limestone, chert, and sandstone--all systems (18-36)	45-65	2.0-4.5	Rapid	Moderate	C-D	Very low	Very low.

[1] See footnote at end of table.

Table 1-9 .--Interpreted characteristics of soils in landtype associations in study area--Continued

Landtype association	Parent material (depth to bedrock, in inches)	Slope range, in percent	Available water, in inches[1]	Permeability	Erosion potential	Hydrologic group	Revegetation potential	Mass movement and slumping potential
6	Permian-Triassic, and Carboniferous limestone, sandstone, chert, and shale (20-40)	45-75	2.5-6.5	Moderate	High	C	Low	Moderate to low.
7	Cretaceous limestone and some sandstone (20-40)	45-75	3.0-6.5	Moderate	High	C	Low	High.
8	Mostly Cretaceous sandstone and limestone (20-60)	35-60	6.0-9.0	Slow	High	D	Moderate	Very high.
9	Cretaceous sandstone, shale, limestone, and conglomerate (40-60)	30-40	7.5-10.0	Slow	Moderate	B	Very high	High.

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[1] See footnote at end of table.

Table 1-9.--Interpreted characteristics of soils in landtype associations in study area--Continued

Landtype association	Parent material (depth to bedrock, in inches)	Slope range, in percent	Available water, in inches[1]	Permeability	Erosion potential	Hydrologic group	Revegetation potential	Mass movement and slumping potential
15	Wasatch (Triassic) sandstone and conglomerate (20-48)	15-35	5.0-10.0	Slow to moderate	High	D-C	Moderate	Very low.
16	Triassic limestone and shale (20-40)	5-25	4.5-7.0	Moderate to high	Moderate	C-B	Moderate	Very low.
17	Thaynes limestone (Triassic) (48-60)	40-70	4.0-8.0	Moderate	High	C-B	Low	Very low.
18	Alluvium (>60)	0-2	(Soils are usually covered with water all year)					
19	Loess over Snake River Basalt (60+)	5-15	8.0-12.0	Slow	High	A	Very high	Moderate.

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[1] Capacity in total average profile.

Table 1-9.--Interpreted characteristics of soils in landtype associations in study area--Continued

Landtype association	Parent material (depth to bedrock, in inches)	Slope range, in percent	Available water, in inches[1]	Permeability	Erosion potential	Hydro-logic group	Revege-tation potential	Mass movement and slumping potential
10	Cretaceous limestone, sandstone, shale, and chert (24-48)	40-65	4.5-7.0	Moderate to slow	High	C	Moderate to high	Very high.
11	Loess (48-60+)	5-25	10.0-12.0	Slow to moderate	High	B	Very high	Low.
12	Limestone, sandstone, and shale--mixed systems (12-36)	35-75	3.0-4.5	Moderate	Moderate	C-D	Low	Moderate.
13	Cretaceous limestone, sandstone, and shale (20-40)	45-75	3.0-6.5	Slow	Moderate to high	C-D	Moderate to low	Moderate to high.
14	Alluvium-colluvium of shale, sandstone, and limestone (36-60)	10-30	8.0-11.0	Slow	Very high	C	Moderate to low	Moderate.

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[1] See footnote at end of table.

Table 1-12--Soil families included in landtype associations

Landtype association and name		Soil families
1	Mountain valley bottomlands	Argic Cryoborolls, fine, montmorillonitic. Cryic Pachic Paleoborolls, fine-loamy, mixed. Pachic Cryoborolls, loamy-skeletal, mixed. Cumulic Cryaquolls, fine-loamy, mixed.
2	Stable mountain sideslopes	Mollic Cryoboralfs, loamy-skeletal. Cryic Paleoborolls, fine-loamy, mixed. Calcic Cryoborolls, loamy-skeletal, mixed. Typic Cryoborolls, fine-loamy, mixed. Lithic Cryoborolls, loamy-skeletal, mixed.
3	Stable mountain uplands	Argic Cryoborolls, loamy-skeletal, mixed. Typic Cryorthents, loamy-skeletal, mixed. Argic Pachic Cryoborolls, loamy-skeletal, mixed. Pachic Cryoborolls, loamy-skeletal, mixed. Typic Cryoborolls, fine-loamy, mixed. Mollic Cryoboralfs, loamy-mixed.
4	Moderately stable cold foothills	Pachic Cryoborolls, loamy-skeletal, mixed. Argic Pachic Cryoborolls, fine, montmorillonitic. Cryic Pachic Paleoborolls, fine, montmorillonitic. Argic Cryoborolls, fine, montmorillonitic.
5	Ridgelands	Argic Cryoborolls, loamy-skeletal, mixed. Typic Cryoborolls, loamy-skeletal, mixed, shallow. Lithic Cryoborolls, loamy-skeletal, mixed.
6	Stable canyonlands	Mollic Cryoboralfs, loamy-skeletal, mixed. Lithic Cryoborolls, loamy-skeletal, mixed. Calcic Pachic Cryoborolls, fine-loamy, mixed. Typic Cryoborolls, fine-loamy, mixed, shallow.
7	Unstable dry foothills	Calciorthidic Haploxerolls, fine-loamy, mixed, frigid. Calcic Pachic Haploxerolls, fine-loamy, mixed, frigid. Lithic Haploxerolls,loamy-skeletal, carbonatic, frigid.
8	Unstable cold foothills sideslopes	Argic Pachic Cryoborolls, fine-loamy, mixed. Argic Cryoborolls, fine, montmorillonitic. Argic Lithic Cryoborolls, loamy-skeletal, mixed.
9	Unstable mountain uplands	Mollic Cryoboralfs, loamy-skeletal, mixed. Pachic Cryoborolls, fine-loamy, mixed. Cryic Pachic Paleoborolls, fine, montmorillonitic.

Table 1-10--Soil families included in landtype associations--Continued

Landtype association and name		Soil families
10	Unstable mountain sideslopes	Mollic Cryoboralfs, loamy-skeletal, mixed. Cryic Paleoborolls, fine-loamy, mixed. Typic Cryoborolls, fine-loamy, mixed. Argic Cryoborolls, loamy-skeletal, mixed.
11	Moderately stable toeslopes	Cryic Pachic Paleoborolls, fine-silty, mixed. Argic Pachic Cryoborolls, fine-silty, mixed.
12	Unstable scarp and dip uplands	Mollic Cryoboralfs, loamy-skeletal, mixed. Argic Cryoborolls, fine-loamy, mixed. Lithic Cryoborolls, loamy-skeletal, mixed.
13	Unstable canyonlands	Typic Cryoborolls, fine-loamy, mixed. Mollic Cryoboralfs, loamy-skeletal, mixed. Argic Pachic Cryoborolls, fine-loamy, mixed. Lithic Cryoborolls, loamy-skeletal, mixed.
14	Mountain basinlands	Cryic Pachic Paleoborolls, fine-montmorillonitic. Cryic Paleoborolls, fine-loamy, mixed. Typic Cryoborolls, fine-loamy, mixed.
15	Low dip and scarp slopes	Vertic Calcixerolls, fine-loamy, montmorillonitic. Calcixerollic Xerochrepts, loamy-skeletal, mixed. Lithic Xerochrepts, loamy-skeletal, mixed. Typic Calcixerolls, fine-loamy, mixed.
16	Rounded ridge slopes	Calcic Argixerolls, fine-loamy, mixed. Typic Argixerolls, fine-loamy, mixed. Lithic Xerochrepts, fine-loamy, mixed.
17	Limestone talus slopes	Calcic Argixerolls, fine-loamy, mixed.
18	Marshlands	Cryic Histosols.
19	Moderately stable loess-covered hills and plains	Cumulic Cryaquolls, fine-silty, mixed. Pachic Cryoborolls, coarse-silty, mixed. Argic Pachic Cryoborolls, fine-silty, mixed.

combine to cause mass movement in the form of slumping. Landtype associations 7, 8, 9, 10, and 13 are subject to slumping because of the inherent instability of the soils.

Landtype associations 6, 7, 8, 10, 11, 14, 15, 17, and 19 have high erosion potential. Most soils have adequate ground cover, and, therefore, there are no major soil-erosion areas. These soils, however, erode easily where vegetal cover is removed or reduced. Steep slopes, shallow soils, and low soil productivity augment erosion and, consequently, the offsite sediment impact.

Some lowlands in association 1 and all of association 18 are extemely wet and marshy. Excavations in these soils cave and slump readily.

Within landtype associations, no calculation of the areal extent of soil families has been attempted.

Landtypes are the next lower or more detailed level of soil mapping. These units are subdivisions of landtype associations and are the basic units of the land systems inventory. They are natural portions of the landscape resulting from geomorphic and climatic processes that have predictable behavior patterns. They have defined patterns of soils and vegetative potentials. Each delineation may include one to several soil families that are recognized by percentage composition but are not specifically located within the landtype. For this study, soils were classified according to the Soil Conservation Service's system (1971).

Information for establishing these landtype associations comes from three sources: 200,000 acres within the Caribou National Forest Diamond Creek Planning Unit were field mapped; the remaining national-forest land was typed by extrapolation and photo interpretation based on the field-mapped portion; and information for non-national-forest land was taken from a statewide Soil Conservation Service soils map.

Descriptions of each landtype association follow. Numbers of the descriptions correspond to numbers on map 4.

Landtype association 1--Mountain valley bottomlands

Elevations range from 6,250 to 7,500 feet above mean sea level. These lands are nearly level to gently sloping mountain valley bottomlands and lower toeslopes. Most soils are alluvial. Slopes range from 1 to 25 percent. The topography is generally smooth to gently sloping, and shallow drainage channels range from wet to intermittently wet and dry. Some soils are flooded during spring and early summer.

The soils are over 36 inches deep, are well to poorly drained, and have a high to very high vegetative-productivity potential. Soil textures are generally fine-loamy to loamy over gravelly and cobbly subsoils. Bedrock in most cases is more than 20 feet below the surface.

Nearly all erosion products can be delivered to the streams. Erosion from existing roads often supplies sediment to the stream courses.

Many soil types, especially those near stream channels, are easily compacted. Rodent activity is common in localized areas and severely reduces forage production.

The lower lying alluvial bottomlands have a sagebrush-grass vegetative cover on their drier parts and a riparian cover on the wet bottomlands near the permanent streams and the intermittently wet channels. The toeslopes are steeper and have a vegetative cover of mixed aspen overstory above a grass and shrub understory. Some toeslope areas have a mixed sage-grass and mountain-brush vegetative cover. At higher elevations, a few alluvial fans support a cover of conifer timber above grass or sedge.

Sagebrush can be eradicated and/or vegetation manipulated with good to excellent results for forage production. The fine-textured, wetter soils have poor bearing strengths. This association occupies about 15 percent of the area.

Landtype association 2--Stable mountain sideslopes

Dominant elevations range from 6,500 to 7,800 feet above mean sea level. These lands are adjacent to the major or larger mountain valleys. They also adjoin the bottomlands landtype association in many places, include some steep rocky escarpments, and are variably dissected. Slope gradients range from 30 to 65 percent but are commonly 35 to 55 percent.

The soils range from moderately deep (20 to 36 inches) to deep (over 36 inches). Surface soils range from non-stony to stony and have loamy textures; subsoils range from loams to clay loams with considerable amounts of coarse fragments. Depth to bedrock averages from 2 to 4 feet.

Erosion potential is moderate to high under natural vegetative cover and very high where the cover on steep slopes has been removed. Much of the eroded sediment can reach the streams.

Moderate water-holding capacity of the soils may restrict vegetative productivity in some areas. Moderate timber-productivity potential exists on forested sites. Usable range-forage production is low to moderate.

This association has low to moderate mass-failure potential, and there is little natural slope movement or slumping.

South- and West-facing slopes have a sagebrush-grass-forb vegetative type, which varies widely in productive potential. Most extreme south-facing slopes have a very low productivity potential. The north- and west-facing slopes have intermixed stands of aspen, lodgepole pine, and Douglas fir; some north-facing slopes have nearly pure stands of Douglas fir.

This association occupies about 4 percent of the area.

Landtype association 3--Stable mountain uplands

Landform shapes, dissection, and geology in the association are highly variable. Dominant elevations range from 6,800 to 8,500 above mean sea level. These lands are the upper mountain slopes of the high mountain ranges, and the total relief is mostly less than 1,000 feet. Slope gradients range from 25 to 60 percent, but are commonly 25 to 45 percent. These high-lying lands and the headwaters of drainages occupy the subdued, rounded to rolling, moderately steep uplands.

The soils range from moderately deep (20 to 36 inches) to deep (over 36 inches). Surface stoniness and some rock outcrops occur throughout the association. Surface-soil textures are generally gravelly loams; subsoil textures, loams and gravelly and cobbly loams. Depth to bedrock varies from 2 feet to over 5 feet.

Erosion potential is directly related to ground cover and slope gradient. Much of the association has moderately high surface-erosion potential.

The overall natural slope stability is good, and there is little mass wasting. Usually, drainages are widely spaced and are not deeply dissected. The association includes all aspects. Open parklike areas are intermixed between the semiclosed conifer timber stands.

This association is the main water-producing and water-storage area providing subsurface and surface water to streams. Domestic livestock and big-game wildlife graze the land, and there are some commercial stands of timber. This association occupies about 5 percent of the area.

Landtype association 4--Moderately stable cold foothills

Dominant elevations of this association range from 6,000 to 7,500 feet above mean sea level. It has low relief and weakly to moderately dissected low-foothill topography. Slopes range from 35 to 55 percent. The association occurs mostly as separate land bodies in the lower, hilly, and foothill locations below steeper and higher mountain slopes and ridges. The overall topography is gently rolling to moderately sloping foothills that are usually extensions of higher ridge and mountain-slope systems.

The soils are in the cryic soil-temperature regime and range from moderately deep (20 to 36 inches) to deep (over 36 inches). Very gravelly and cobbly surface textures are dominantly loamy. Moderate slumping occurs in areas with clay and clay-loam subsoils, especially where the natural slopes have been disturbed. Slope stability in some local areas is poor. Most surface erosion occurs in areas where the vegetative cover on the least productive sites has been destroyed.

Vegetation varies widely. A sagebrush-grass type predominates on south aspects. Some intermixed stands of conifer and aspen occur on the west and east exposures of slopes; conifer stands on some--but not all--north-facing aspects; and intermixed stands of conifer and aspen, on any aspect, except south, in most of the areas. This association has moderate range-forage productivity potential and low conifer-species productivity potential. It occupies about 4 percent of the area.

Landtype association 5--Ridgelands

Dominant elevations range from about 8,000 to 9,500 feet above mean sea level. This association includes the fairly narrow, elongated, and somewhat smooth system of ridges and/or mountain tops at the highest elevations in the area. Slopes are usually steep, ranging from 45 to 65 percent. Some ridges have shallow depressions that extend from their crests to their bases. Rock outcrops are common but small. This association contains many of the phosphate ore beds.

The soils range from shallow (less than 20 inches) to moderately deep (20 to 36 inches). Depth to bedrock ranges from less than 1 foot to around 3 feet. Nearly all soils are very stony and gravelly. Small, nearly vertical, rock cliffs occur locally, but the outcrops are small in size and extent.

The soils have a very low forage productivity potential and low revegetation potentials, owing to the shallow stony soils, their low water-holding capacity, and a cold climate. Erosion potential is high.

Vegetation varies widely, depending on aspect, elevation, and geology. Much of the high elevation has a nearly barren, forb-grass vegetative type. On deeper soils, sagebrush-grass vegetative types predominate.

Phosphate-mining activities have caused erosion because of the steep slopes and the extreme difficulty in revegetating the slopes. This association is highly visible from nearly all points. It occupies about 1 percent of the region.

Landtype association 6--Stable canyonlands

Dominant elevations range from about 6,500 to 8,000 feet above mean sea level. This association comprises the steep, moderately to strongly dissected, V-shaped canyons. Slopes range from 45 to 75 percent. Rock outcrops are numerous and common, but they are far more abundant on south aspects. Only larger canyons contain permanent streams.

The soils are shallow (less than 20 inches) and moderately deep (20 to 36 inches). Surface soils are stony to gravelly and have loamy textures. Nearly all subsoils are very gravelly and/or cobbly. Depth to bedrock ranges from 1 to 3 feet over most of the area.

Erosion potential is high in much of the area, but much of the sediment produced in the dry canyon is retained onsite. Slope stability in small portions of the area is poor, and slope failure may occur from ground-disturbing activities.

Vegetation on south and west exposures consists of sagebrush-grass and scattered mountain brush. North- and some east-facing aspects have mixed stands of conifer and aspen.

This association provides winter habitat for big-game wildlife. Some steep south-facing slopes have a low production potential for usable forage. This association occupies about 4 percent of the area.

Landtype association 7--Unstable dry foothills

Dominant elevations range from 6,200 to 6,800 feet above mean sea level. This association consists of steep, moderately dissected foothills that adjoin the major river bottomlands. These areas occur at the lowest elevations along the western edge of the Caribou Range. The topography contains many scarp slopes caused by faulting along the lower base of the mountains. Slopes range from 35 to 70 percent. Rock outcrops cover about 15 to 25 percent of the unit.

The soils are in the drier soil moisture regime and range from shallow (less than 20 inches) to moderately deep (20 to 36 inches). Surface textures are stony loams; subsoil textures, gravelly loams or gravelly clay loams that are strongly calcareous. Depth to bedrock varies from 1½ feet to over 5 feet.

Slope stability is poor, and slumping potential is high in areas with deeper soils--especially on slopes that have been disturbed.

This unit has high erosion potential. Much of the area is severely eroded. Most surface erosion occurs where the vegetative cover has been reduced or on the least productive sites.

Vegetation varies with aspect. A sagebrush-grass type predominates on nearly all aspects except north. Intermixed stands of conifer and aspen occur on northeast exposures of the higher slopes. Conifer stands occur on some north-facing aspects.

This association has low range-forage productivity potential and a very low conifer-species productivity potential. It occupies about 17 percent of the region.

Landtype association 8--Unstable cold foothills sideslopes

Dominant elevations range from 6,500 to 7,500 feet above mean sea level. This association adjoins high mountains and is a complex of steep to moderately steep mountain sideslopes and upper foothills. The topography is generally broken and uneven. Slopes range from 30 to 65 percent. Rock outcrops cover about 15 percent of the unit.

The soils are in the cold soil-temperature regime. Surface-soil textures are dominantly silt loams; subsoil textures range from clay loams to silty clay loams. Depth to bedrock covered by developed soils is approximately 2 to 4 feet but is less than 2 feet near outcrops.

This unit has very low mass stability and high slump potential. Erosion potential is also high, and moderate surface-erosion problems exist in much of the area where natural ground cover has been reduced or removed.

Vegetation varies widely: Roughly one-third of the association is covered with conifer-aspen; one-third, with aspen-brush; and one-third, with mountain brush. The conifer-aspen type generally occurs on northerly aspects. This association occupies about 6 percent of the region.

Landtype association 9--Unstable mountain uplands

Landform shapes, dissection, and geology in the association are highly variable. Dominant elevations range from 7,500 to 8,500 feet above mean sea level. These lands are the upper slopes of the high mountain ranges, and they include some of the higher elevations in the area. Total relief is not great--mostly less than 800 feet. Slopes range from 30 to 60 percent but are commonly 30 to 45 percent. These upland slopes and the headwaters of drainages occupy the subdued, rounded to rolling, moderately steep uplands. Usually, the drainages are widely spaced and are not deeply dissected.

Soils range from moderately deep (20 to 36 inches) to deep (over 36 inches). Surface stoniness and some rock outcrops occur throughout the association. Surface-soil textures are generally heavy loams to clay loams; subsoil textures are gravelly and cobbly clay loams and clays. Depth to bedrock varies from 3 feet to over 5 feet. Much of the association has moderately high erosion and slump potential. It is a major water-producing and water-storage area for sustained streamflow.

Conifer-aspen and sagebrush-grass types occur on many aspects and slopes. Open parklike areas of sagebrush-grass are intermixed between semiclosed conifer-aspen stands. There are some commercial stands of timber.

The productivity potential for usable range forage is moderate. Timber productivity potential is low, except on north-facing slopes, which have a moderate to high productivity potential. This association occupies about 3 percent of the area.

Landtype association 10--Unstable mountain sideslopes

Dominant elevations range from 6,500 to 7,800 feet above mean sea level. This association includes valley sideslopes that adjoin major or larger valleys, as well as some steep, rocky escarpment lands with south aspects. In many places, it adjoins the uplands landtype association. These sideslopes vary in degree of dissection, and their slopes range from 30 to 75 percent but are commonly 40 to 65 percent.

The soils range from moderately deep (20 to 36 inches) to deep (over 36 inches). Surface soils range from nonstony to stony, and their textures are loamy. Subsoil textures range from light clays to clay loams, with considerable amounts of coarse fragments. Depth to bedrock averages from 2 to 4 feet.

A moderate to high erosion potential exists under natural vegetative cover conditions, but the potential is very high where the surfaces of steep slopes have been denuded. Much sediment can reach the streams. Slump potential is extemely high, and many slopes fail on undisturbed slopes.

South- and west-facing aspects have a sagebrush-grass vegetative type that varies widely in productive potential. Some of the exteme south-facing aspects have an intermixed conifer-aspen stand. Some north-facing slopes have nearly pure stands of Douglas fir.

Moderate timber productivity potential exists on forested sites. Usable forage production is low to moderate. This association occupies about 2 percent of the area.

Landtype association 11--Moderately stable toeslopes

Dominant elevations range from 5,600 to 6,000 feet above mean sea level. These lands have very low relief and are very weakly dissected toeslopes that occur at the base of the mountain slopes joining the valleys. Slopes range from 5 to 25 percent. This association is believed to be a loess cap deposited on the Snake River Basalt and the Salt Lake Formation.

Soils are in the cold soil-temperature regime. They are deep and very deep, loess-derived soils over bedrock and they lack stones and gravel. Surface soils are dominantly thick and dark; their textures are mainly silt loams. Subsoil texture ranges from silty clay loams to heavy silt loams. Depth to hard bedrock is generally greater than 10 feet.

Natural vegetation consists mainly of mountain brush and sagebrush-grass, as well as some aspen stands in small isolated areas. Most of this unit has been cultivated into dry farms.

Erosion potential is high to very high. This association occupies about 3 percent of the area.

Landtype association 12--Unstable scarp and dip uplands

Dominant elevations range from 6,400 to 8,000 feet above mean sea level. This association consists of generally very steep scarp slopes facing southwest and moderately steep dip slopes facing northeast. Most scarp and dip slopes are about the same length. Relief ranges from 500 to 1,500 feet. Slopes range from 35 to 75 percent. Rock outcrops cover as much as 30 percent of the association.

The soils range widely in physical characteristics, owing to aspect or exposure, depth to bedrock, and--to some extent--elevation. Most soils on scarp slopes are shallow (less than 20 inches) to moderately deep (20 to 36 inches). Their surface-soil textures range from very stony loams to silt loams; subsoil textures range from stony loams to stony clay loams. Depth to bedrock ranges from 1 to 3 feet. Dip-slope soils are deeper, with bedrock depths ranging from 2 to 4 feet. Soil textures are somewhat finer but are basically the same as those of scarp-slope soils.

Erosion potential is moderate on scarp-slope soils and low to moderate on dip-slope soils. There is a moderately high potential for mass movement, mostly in the form of slumping.

Mountain brush dominates the vegetation on southerly aspects; mixed conifer-aspen, on northerly aspects. This association occupies about 2 percent of the area.

Landtype association 13--Unstable canyonlands

Dominant elevations range from about 6,500 to 8,500 feet above mean sea level. This association includes steep, moderately to strongly dissected, V-shaped canyons. Slope gradients range from 45 to 75 percent. Rock outcrops cover about 20 percent of the area, mostly on south aspects. Only the larger canyons have permanent streams; most of the remaining drainages have intermittent or ephemeral streams.

The soils are shallow (less than 20 inches) and moderately deep (20 to 36 inches). Surface soils are stony to gravelly, and their textures are stony loam. Subsoils are very gravelly and/or cobbly; their textures range from loams to clay loams. Depth to bedrock ranges from 1 to 3 feet over most of the area.

Erosion potential is high on much of the area, but much of the eroded sediment is retained onsite. There is a high potential for mass movement as slumping. Some slope failures have occurred on undisturbed areas.

Vegetation on south and west exposures consists of sagebrush-grass and scattered mountain shrubs. North- and some east-facing aspects have stands of conifer and aspen.

This association provides winter habitat for big-game wildlife. Some of the steep south-facing slopes have low potential for usable forage production. This association occupies about 3 percent of the area.

Landtype association 14--Mountain basinlands

Dominant elevations range from 6,500 to 7,000 feet above mean sea level. These lands are smooth to rounded, gently sloping, mountain basins that are generally surrounded by higher lands. Slopes range from 10 to 30 percent. The soils are outwash from higher elevations. These lands presumably formed during periods of large fluvial action in the mountains. Dissection varies, but nearly all depressions are less than 15 feet deep.

The soils are over 36 inches deep and are well drained. Surface-soil textures range from clay loam to loam; clay, silty clay, and clay loams dominate the subsoil texture. About half of the subsoils have more than 35 percent coarse fragments. Depth to hard bedrock varies from 3 to 6 feet.

Erosion potential is high to very high, and topsoil and surface soils have already been eroded from sizable areas. Soil permeability is slow to very slow. The soil is easily compacted, and the revegetation potential is low to moderate.

Sagebrush-grass is the characteristic vegetal cover, with minor amounts of mountain brush. This association occupies about 1 percent of the area.

Landtype association 15--Low dip and scarp slopes

Dominant elevations range from 6,600 to 7,600 feet above mean sea level. This association consists largely of colluvial red soils derived from the Nugget Sandstone and the Wasatch Conglomerate. Bedrock covers from 10 to 30 percent of the steep scarp-slope surface.

The association occurs on dip slopes and scarp slopes. Some alluvial soils occur in floodplains at the lower elevations. Dip slopes range from 10 to 30 percent; scarp slopes, from 20 to 50 percent; and floodplain slopes are less than 5 percent. The dip slopes have deep drainage depressions, which are dry throughout the year except during spring runoff and high-intensity rainstorms. The scarp slopes have shallow drainage depressions, which are dry throughout the year. The low floodplains have perennial streams fed by springs and seeps that flow from dip-slope bedding planes.

The soils range from shallow (less than 20 inches) to deep (over 36 inches), depending on the type of slope. Soil textures are generally fine loamy to loamy skeletal, and some soils contain gravelly horizons. The soils are eroded readily owing to sparse vegetative cover.

Vegetation consists mostly of sagebrush-grass on colluvial soils and mountain brush and varied grasses on alluvial soils. Surface cover ranges from 30 to 40 percent.

About one-half of this association is used for grazing and one-half for dry-land farming. Rodent holes are common in unplowed areas.

This association occupies about 3 percent of the region.

Landtype association 16--Rounded ridge slopes

Dominant elevations range from 6,600 to 7,400 feet above mean sea level. This association consists largely of white soils derived from shales and limestones of the Twin Creek Formation. Bedrock outcrops cover from 5 to 15 percent of the surface. The soils are mixed alluvium and colluvium from ancient alluvial fans, floodplains, and alluvial-colluvial toeslopes derived from the surrounding slopes. Most topography is smooth to somewhat dissected, with drainage channels that are dry throughout the year except during spring runoff and high-intensity rainstorms. The low-lying floodplains have perennial streams and wet soils.

The soils range from shallow (less than 20 inches) to deep (over 36 inches). Soil textures are generally fine loamy to loamy, and coarse fragments occur in some shallow profiles. The soil erodes readily owing to sparse vegetative cover, and it compacts easily.

Vegetation consists mostly of sagebrush-grass on the alluvial and colluvial slopes, with the heavier accumulations along the drainage channels. Vegetation on the scarp slopes consists mainly of low sagebrush. The surface cover is only about 10 to 20 percent. Riparian vegetation occupies the low wet floodplains.

Most of this association is used for grazing. Rodent activity and holes are common. This association occupies less than 0.5 percent of the area.

Landtype association 17--Limestone talus ridges

Dominant elevations range from 6,000 to 7,600 feet above mean sea level. These lands are long talus slopes derived from limestone of the Thaynes Formation. About 20 to 30 percent of the surface is covered by talus. The soils are mostly colluvial. They occur on steep ridge slopes which range from 40 to 70 percent.

The soils are moderately deep (20 to 36 inches) to deep (over 36 inches). Textures are generally fine loamy and loamy skeletal, and some soils contain gravelly horizons. They are easily eroded.

Vegetation consists mostly of sagebrush-grass and some mountain brush. This association occupies less than 0.5 percent of the area.

Landtype association 18--Marshlands

Dominant elevations range from 5,900 to 6,600 feet above mean sea level. Slopes range from 0 to 2 percent. Soils are usually wet yearlong, and flooding occurs during spring and early summer.

The soils are mainly Histosols and are in the cold soil-temperature regime.

Natural vegetation consists of the marshlands vegetative type. This association occupies about 3 percent of the area.

Landtype association 19--Moderately stable loess-covered hills and plains

Dominant elevations range from 5,000 to 6,000 feet above mean sea level. This association consists of weakly dissected low foothills of low relief and of nearly level to rounded and rolling, moderately steep uplands. The soils are loess deposited on bedrock of Snake River Basalt and Salt Lake Formation.

The soils are in the cold soil-temperature regime. They range from shallow (less than 20 inches) to very deep, and depth to bedrock usually exceeds 10 feet. The soils lack stones and gravel. Surface soils are dominantly thick and dark, and their textures are mainly silt loams. Subsoil textures range from silty clay loams to heavy silt loams. Erosion potential is high to very high.

The natural vegetation consists of sagebrush-grass, mountain brush, with some aspen stands in small isolated areas. Much of the area is cultivated for dry farming. This association occupies about 23 percent of the region.

Geobotanical studies, made by the U.S. Geological Survey for the Task Force, identified the distribution and concentrations of trace elements in soils, particularly in the vicinity of phosphate-processing plants in the area. Sampling and analytical techniques and results of the 1975 study are detailed in the report to the Task Force. Distribution curves for selected elements are shown in figure 1-11.

Of the 26 elements tested by regression analyses 14 showed a significant trend to the northeast of the Pocatello plants. Concentrations of 14 trace elements (beryllium, copper, fluorine, iron, lead, lithium, mercury, nickel, manganese, potassium, rubidium, titanium, vanadium, and zinc) increased in the A-horizons (0-5 cm.) of soils as the processing

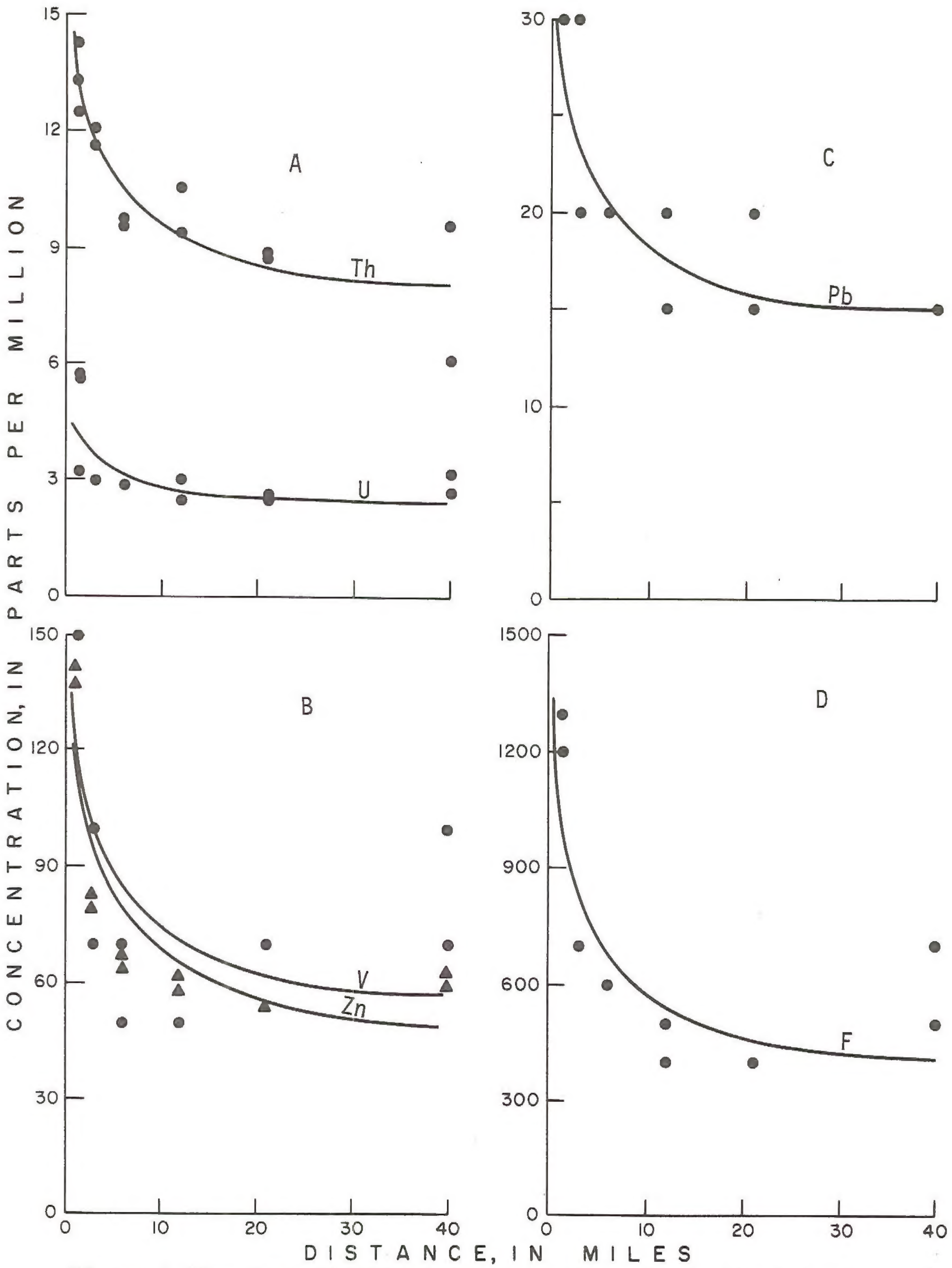

Figure 1-12.--Concentrations of trace elements in the A horizon of soils along the northeast transect at Pocatello as a function of distance from processing plants. A, thorium (Th) and uranium (U); B, vanadium (V and circle) and zinc (Zn and triangle); C, lead (Pb); D, fluorine (F).

plants at Pocatello are approached.

Expected concentrations of these trace elements, as determined by regression analysis, are as follows:

Element	Concentration (PPM) at Indicated Distances from Processing Plant			
	1 Km.	5 Km.	10 km.	50 km.
Beryllium	1.9	1.5	1.4	1.1
Copper	23	20	19	16
Fluorine	1340	820	660	410
Iron	2.2	1.9	1.8	1.6
Lead	31	23	20	15
Lithium	26	22	21	17
Mercury	0.4	0.03	0.02	0.02
Nickel	29	23	20	16
Manganese	0.08	0.06	0.06	0.05
Potassium	2.0	1.8	1.8	1.6
Lithium	3300	2900	2800	2500
Vanadium	134	95	82	58
Zinc	146	94	78	50

Concentrations of these elements within 1 mile of the plants are typically about twice their concentrations 30 miles away. The concentration of fluorine within 1 mile of the plants is about three times its concentration 30 miles away. The observed concentrations of fluorine, lead, manganese, mercury, rubidium, and zinc are unusually high within 0.5 to 1 mile of the plants, when compared with near-background levels measured at 40 miles from the plants. The following 12 elements also were analyzed by regression analysis, but no significant trends were indicated: aluminum, calcium, carbon, cobalt, chromium, gallium, magnesium, niobium, silicon, sodium, tin, and ytterbium.

Around the Soda Springs processing plants, the concentrations of elements in soil exhibit no clear patterns with respect to the processing plants, possibly because of the diversity of soil types at the sampling localities.

Elevated levels of lithium, manganese, nickel, and zinc may interfere with vegetative health; fluorine, lead, manganese, mercury, and zinc may be toxic to animals if ingested; fluorine, manganese, nickel, rubidium, vanadium, and zinc are known, or suspected, to occur in forms that are biologically usable by animals and humans. Mercury and lead have long been recognized as environmental hazards.

Studies by the USGS for the Task Force indicate that no particular section of the Phosphoria is more supportive of bacterial growth than any other section, and therefore no section was any better than the others for use as a topsoil substitute. In the tests, 21 individual rock samples weighing 0.5g each were slurried in 100 ml of deionized water containing 5 mg of glucose. All samples were run in 5-fold replication. All samples including 4 rock-free controls were inoculated with one drop of a soil-water suspension. The inoculation insured that the rock sample was exposed to a varied microbial population. Inoculated samples were taken for standard plate counts after 7 and 14 days.

The fact that significant amounts of bacterial-supporting nutrients were not released in the 14-day period, however, does not mean that considerable quantities of nutrients are not potentially available. Their rate of release may be slow.

3. WATER RESOURCES

a. Water Supply

Present multipurpose uses of the water resources in the area include municipal supplies, industrial use, irrigation, domestic use, stock watering, recreational use, and power generation. Patterns of streamflow are significantly affected by regulation for these uses. Little water is needed or used at present in the mining of phosphate rock. Principal minesite uses are for dust control, washing equipment, watering revegetated areas, test-hole drilling, and other minor needs. However, significant quantities of water are used in processing plants near Pocatello and Soda Springs.

The study area includes parts of four major drainages: the Portneuf, Blackfoot, and Salt Rivers--tributaries to the Snake River--and the Bear River--tributary to the Great Salt Lake. These streams drain about 90 percent of the study area; the remaining 10 percent is drained mostly by Willow Creek and several other tributaries to the Snake River.

The base flow of all these streams is mainly from springs in the mountain and valley areas. Spring flows range from little more than a seep to as much as 29 cfs (cubic feet per second). These springs are the discharge points for ground-water systems that range from isolated water bodies a few square yards in area in small alluviated valleys to water bodies covering thousands of acres in lava fields or extensive sedimentary formations.

Many of the small streams at higher elevations flow only in the wet season, but others are fed by large springs that are perennial. The larger interridge streams including Diamond, Slug, Trail, and Sheep Creeks, portions of Dry Valley and Angus Creeks, and many of their tributaries are perennial.

The average annual runoff from the phosphate area of the Caribou National Forest is about 643,000 acre-feet, which is about 50 percent of the runoff from the entire southeast Idaho phosphate area (Idaho Univ. Water Resources Research Inst., 1968). The highest runoff results from snowmelt in spring months. In the summer months, most precipitation is absorbed into the soil with little or no consequent runoff.

Ground-water recharge occurs during the snowmelt season. This water slowly moves through alluvium or bedrock and commonly emerges at lower altitudes as spring flow or base flow of streams. In the study area, enough ground water is stored and is released slowly enough to sustain flow in most of the larger streams throughout the dry season.

1. Surface Water

The study area is drained by two large river systems, the Bear River and the Snake River (map 1).

The Bear River heads in Utah, flows across the southwest corner of Wyoming, and enters Idaho and the study area south of Border, Wyoming. Practically the entire flow is diverted into Bear Lake, where it is stored for irrigation and power development. The stored water is released to flow northwestward through the natural channel past Soda Springs to Alexander, where it leaves the study area and continues southward to the Great Salt Lake in Utah. The southerly portion of the study area is in Bear River basin.

Principal tributaries of Bear River between Border and Alexander include Thomas Fork, Montpelier Creek, Bear Lake Outlet (which collects discharge from St. Charles, Bloomington, Paris, and Mill Creeks), Georgetown, Eightmile, and Soda Creeks. The discharge of the river averages about two-thirds greater at Alexander than at Border.

The Snake River flows into Idaho from Wyoming at Alpine, about 65 miles north of Border. It flows northwestward through Palisades Reservoir and thence to Heise, where it enters the Snake River Plain and flows southwestward to American Falls Reservoir. Tributaries of the Snake River in downstream order include Salt River, McCoy, Bear, Fall, and Willow Creeks and Blackfoot and Portneuf Rivers. Salt River collects the flow of Crow, Stump, and Tincup Creeks, which drain the eastern slopes of the study area. McCoy, Bear, and Fall Creeks drain the northerly slopes of the Caribou Range into the Snake River. Willow Creek and Blackfoot and Portneuf Rivers drain the northwest section of the study area.

The streamflow characteristics in the study area vary in a wide range because of climatic, topographic, and geologic features discussed in other sections of this report. Since precipitation is relatively light (10 to 45 inches annually), these features have great impact on streamflow. Streamflow characteristics may change radically from point to point along the same channel, as well as from basin to basin, especially in the small drainage basins.

Practically all streamflow is associated with snowmelt. Snow is usually stored for several months or at least for several storms. Snowmelt then releases greater volumes than are released by individual storms. At times, especially at lower elevations, rain falls on snow or frozen ground when infiltration is minimal and causes flashy runoff. When vapor pressures are high in moist air masses and condensation occurs on snowpacks, the heat of condensation can release large volumes from snowmelt. Rain on the snowpack further augments runoff from the snow. Intense rainfall during thunderstorms causes extreme flooding at times, but areas affected by individual storms are usually small, as are the runoff volumes. Summer precipitation usually falls on dry soils and is absorbed by the soil mantle or the channel and bank storage and may not reach far from the source. In many streams, flow is derived principally from ground water, which flows in patterns complicated by complex structures and hydrologic characteristics of the geologic units. Boundaries of some ground-water divides differ considerably from the surface-drainage divides. Streamflow in many streams, especially the Bear River, the Snake River, and their principal tributaries, are further affected by diversions for irrigation, power, municipal and industrial uses, and by regulation dams and reservoirs used for water management. These effects are discussed elsewhere in the report.

These effects preclude use of most simple relations commonly assumed between precipitation and the characteristics of streamflow. Most streamflow characteristics in the area cannot be generalized with assurance. Onsite data are, by far, the most definitive and useful sources of streamflow data.

Streamflow data collected by several agencies are available at points in or near the study area. However, most streamflow records are on large streams such as Bear River and Snake River and their large tributaries listed above. Few data are available for the small streams that are most directly involved with the proposed mining operations and the proposed leases. However, some generalizations of streamflow characteristics can be made from available streamflow data.

Springs significantly affect the flow characteristics of many of the streams. In addition to Georgetown and Soda Creeks, Bloomington Creek, Paris Creek, Salt River, Crow Creek, Stump Creek, Little Blackfoot River, Portneuf River above Lava Hot Springs, and Portneuf River near Tyhee below Pocatello, are larger streams that receive significant inflows from springs and have high base flows (high flows during the nonstorm or nonsnowmelt periods). They are well sustained during the late summer and winter periods and have relatively low flood peaks. Many small creeks have similar flow characteristics. These include Mill Creek and Kendall Creek, tributaries of Diamond Creek, Sheep Creek, tributary to Lanes Creek, and many others.

Other streams tend to lose water through some of their courses because they are perched above the adjacent ground-water systems and flow through or over alluvium or other permeable bed materials. Many of the streams in the mining and lease areas have this characteristic. Sections of the channels of Maybe Creek, Swan Lake Gulch, Middle Sulphur Canyon, Dry Creek, Dry Valley Creek, Little Blackfoot River, and a large number of the smaller headwater tributaries are dry for long periods. Because flows are small, the smaller streams disappear and reappear more readily than the larger streams. Many of the small drainage channels are dry for long periods. Springs in many of them support perennial flows for short reaches of channels, but the flows often percolate into the streambeds at varying distances from the springs. Streamflow characteristics of several small streams associated directly with the mining operations are described in more detail in Parts 4 to 11.

Precipitation has been described under the section on climate. The annual precipitation on national-forest lands, which include most of the high headwater tributaries of the study area, is about 1,900,000 acre-feet. Runoff is about 640,000 acre-feet, which is 34 percent of the average annual precipitation; the remaining 66 percent of the precipitation goes into ground-water recharge or is returned to the atmosphere by evapotranspiration. This runoff from the national-forest lands is a little over half that of the entire study area.

High-intensity summer storms in vegetated areas with natural or near-natural conditions seldom produce significant runoff--perhaps no more than once in 20 years, on the average. Where the vegetation is reduced and soil characteristics are changed by overuse or by some types of engineering works, runoff and erosion from storms are increased. Flooding occurs more frequently from disturbed areas.

More than 50 percent of the precipitation in the study area falls as snow. On the lee side of many ridges, this snow forms large drifts that last well into the summer. During cold summers, the drifts may last all year. The result is localized areas with extremely short growing seasons that generally support only alpine or arctic types of plants. These "snowdrift areas" constitute a small portion of the area but contribute several times the average runoff of both water and sediment.

Estimates based on data compiled by the Idaho University Water Resources Research Institute (1968) indicate that the entire study area yields about 1,200,000 acre-feet of water annually. About 50 percent of this is from headwater areas, most of which are on national-forest lands. This runoff from national-forest lands amounts to an average depth of just under 9 inches. However, the average annual volume of flow from national-forest lands is estimated by the U.S. Forest Service as slightly more than 1 foot.

Average annual peak flows having average recurrence intervals of 2 years vary widely. Some larger streams at lower elevations have average annual floods of less than 1 cfs per square mile, while some small streams within the study area have average annual peak flows of more than 10 cfsm. In some high-runoff areas, the average annual peak flows are much larger. The maximum recorded rates are also much larger (fig.1-13). This figure shows the maximum flows in cfs per square mile plotted against drainage area at the sites of record in and near the study area.

Peak runoff usually occurs as a result of snowmelt. The high water from snowmelt generally extends over a 2- to 6-week period--usually in May and June--depending on the weather conditions and the volume of the snowpack. However, some of the highest rates of flow of record are from summer thunderstorms or from rain on snow when heat of condensation causes rapid snowmelt.

In larger streams, the duration of high flows may be extended because of elevation differences within the watershed. That is, the snow at lower elevations will melt and run off first, whereas the higher elevations will retain their snowpacks longer. In small drainages, the high flows last a shorter time because the elevation differences are often smaller and the snow melts over a shorter time period.

Sudden snowmelt from rain and heat of condensation on frozen ground caused extreme flooding in February 1962 and again in 1963 in the lower Portneuf, Blackfoot, Willow Creek, and other basins or parts of basins that range in elevation from 5,000 to 7,000 feet. Damage from the February 1962 floods in the Portneuf River basin, which was the most damaging recent flood in the area, was estimated at nearly $4 million at 1962 prices. The lower Blackfoot lowlands and the lowlands between Pocatello and Idaho Falls also sustained considerable damage. The flood damages in February 1963 were estimated at $2.5 million but were not nearly as widespread in other parts of the study area as those in 1962. Flood flows also have occurred from high-intensity convective storms, usually in summer, which primarily affect small drainage basins. Figure 1-13 shows maximum floods of record in and near the study area. The flood potential is much greater in the Snake River basin than in the Bear River basin.

About 70 percent of the stream channels are in good condition, about 20 percent are in fair condition, and about 10 percent are in poor condition. The stream-channel condition, as used here (good, fair, poor), describes the ability of the channel and banks to resist erosion by the stream and indicates the degree of armoring of the bed and banks by vegetation and rock. Banks that have a combined ground-cover density of vegetation and exposed bedrock of more than 65 percent are considered to be in good condition. Banks that have a combined ground-cover density of less than 40 percent are considered to be in poor condition. All others are considered to be in fair condition.

The high percentage of stream channels in good condition indicates that in most of the watersheds of this area infiltration is high relative to precipitation. Surface runoff and sediment yields are generally low. Areas with low infiltration rates, owing to soil and/or vegetative conditions, such as disturbed mining areas, roads, railroads,

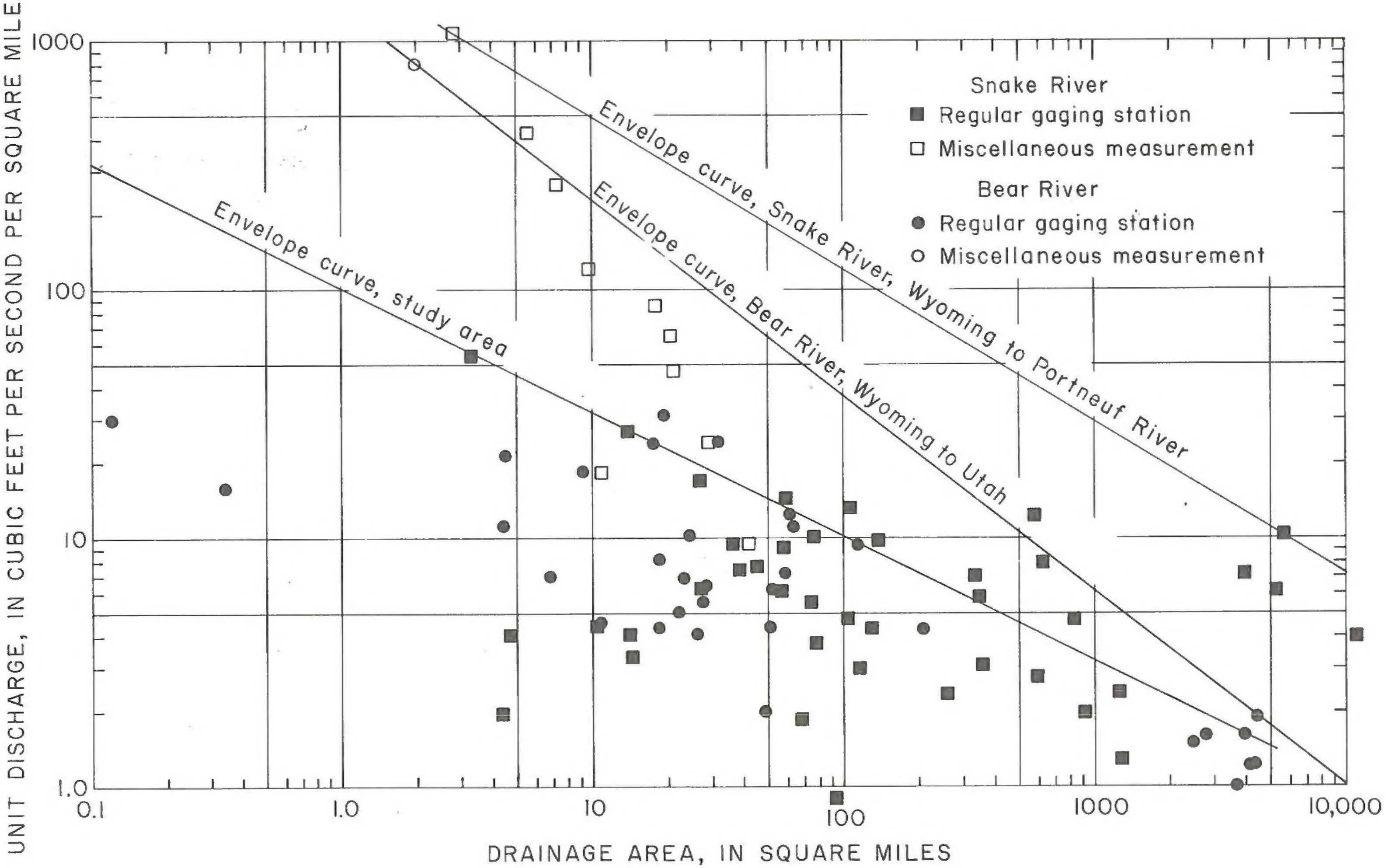

Figure 1-13.--Maximum observed unit discharges and envelope curves in Snake River and Bear River basins.

intensively cultivated and overgrazed areas, impermeable exposed rock areas, and some fragile terrain exposed to extreme winds or overexposed to the sun, are likely to yield extremely high volumes of sediment and runoff.

Erosion and sedimentation depend on the ability of the basin to supply sediment and the ability of the stream to transport the sediment.

Surface erosion due to running water is negligible over much of the undisturbed area of proposed mining, because of relatively low erodibility of soils and generally good vegetative cover. Most erosion is restricted to existing stream valleys, gullies, rills, and very steep slopes or bedrock exposures that lack a cohesive cover of vegetation. Factors that influence erosive processes at specific locations include (1) vegetation; (2) local topography; (3) microclimatic conditions, including rainfall, snow accumulation and rate of melt, and diurnal temperature fluctuations; (4) nature of surface runoff; and (5) composition and texture of the soil, including infiltration and erodibility characteristics.

Gullies begin as rills and generally are formed when infiltration is reduced and excess from rainfall or snowmelt flows overland.

Although studies are in progress, no data on measured rates of erosion in the proposed mining area are available. However, as shown later in this section, erosion rates can be inferred from measured sediment-transport load in rivers. The weighted mean annual suspended-sediment concentration in river channels of the proposed mining area is about 150 mg/l, or 150 parts per million, according to USGS estimates. Data for U.S. Geological Survey gaging station 13063000, Blackfoot River above reservoir, near Henry, Idaho, indicate an average water discharge of 126,100 acre-feet per year and a sediment discharge of 18.9 acre-feet per year. With a drainage area of 350 square miles, this provides a uniform rate of erosion of 0.001 inch per year, or about 1,000 years to erode 1 inch.

The data indicate that existing erosion rates are very low. Even on the assumption that some areas are storing sediment rather than eroding, and that other areas are neither eroding nor filling with sediment, the data still indicate that the remaining areas are not eroding at rates which could be considered troublesome.

A few small reservoirs in the proposed mining area act as sediment traps, and a large part of the sediment runoff is deposited in them. The reservoirs also tend to decrease flood peaks; thus, the energy of the flow and its sediment-transport ability is also reduced. The lifespan of the reservoirs depends on the entering sediment load, their trap efficiency, and their storage capacity.

Many streams in the study area are alluvial. Alluvial streams are dynamic and are in a continual state of changing their positions and shapes as a consequence of hydraulic forces on their beds and banks.

Other streams are entrenched in bedrock or geologically controlled and confined to fixed paths along the valley bottoms. Flood plains are either nonexistent or small, and there is little alluvial material for the river to erode and transport.

Studies by the Agriculture Research Service on Reynolds Creek and its tributaries in the Owyhee Mountains about 50 miles south of Boise show that practically all significant sediment movement occurs during periods of snowmelt. Records as long as 8 years at some sites show no significant sediment movement during the July to November periods. A model developed for this area relates the total suspended sediment for any runoff event to both the peak discharge and the total runoff for the event. Because latitude, elevation, and topography of the Reynolds Creek area are very similar to much of the study area, it is reasonable to assume that sediment movement in much of the study area occurs primarily during periods of snowmelt. Available data for the study area, however, are inadequate to calibrate the model for quantitative estimates in the study area. Although weather records indicate that there may be more summer storms in the study area, more than 90 percent of the runoff and sediment transport occurs during snowmelt periods.

2. Ground Water

The area in which the phosphate rock is mined is very complex structurally. The bedrock strata in this area are offset--in places as much as a mile--by hundreds of faults, and they commonly dip at steep angles or are overturned.

The complex geologic structure and a lack of subsurface hydrologic data make it difficult to describe in detail how ground water enters, flows through, and leaves the bedrock formations. The folding, faulting, and rugged topography have created a myriad of complex, discrete flow systems.

Ground water probably occurs at one place or another in every geologic formation in the mining area. However, the clayey, silty, and deeply weathered units in these formations, such as those in the Phosphoria, have low permeabilities and yield little more than enough water for domestic and stock supplies. The permeable sandstone and fractured limestone, dolomite, and chert beds in the older formations contain water in structurally and topographically favorable areas, and in these areas they probably sustain significant yields to wells.

The bedrock formations (here defined as all formations older than Quaternary age) of Paleozoic and Mesozoic age (see Map 3) are intensely folded, faulted, and jointed. The structure (including the fractures) is the most important factor in the occurrence and movement of ground water in these rocks. Those rocks of Cenozoic age are less deformed, and in these, structure is not as important as lithology to the occurrence and movement of ground water.

The direction of movement of water through the bedrock formations in the mining area cannot be determined, except in a few local areas, with currently available data.

Drill holes indicate that formations that are virtually impermeable in one area are permeable in a nearby area. Brittle, dense, bedrock, such as the chert and limestone units in the Wells Formation, does not transmit water readily in areas where it is not fractured; where it is fractured, as in some fault zones and along the axes of some folds, it commonly contains and transmits water readily. However, the distance and direction that ground water might flow in a given fracture system depends largely on local structure and topography.

In places, fractures in limestone or dolomite units have been widened by solution. Where this has occurred, as in the Bear River Range west of Bloomington, caves and sink holes have formed to become underground passageways for the movement of water. Characteristically, the flow path of water through fractured limestone is tortuous in both horizontal and vertical directions, and it is difficult to define the flow path without extensive test drilling and detailed studies.

The fractured limestone beds, and some of the more permeable sandstone beds, probably are the main sources of water for the numerous large springs throughout the area. The path by which the water arrives at those springs is unknown. However, some spring-fed streams discharge much more water than their drainage basins should yield. This indicates that some of the spring water derives from sources outside the drainage basin in which it discharges. An example of such a spring-fed stream is Cub River, on the west side of the Bear River Range, which discharges the equivalent of 36 inches of precipitation per unit area of its drainage basin, although the average annual precipitation in the drainage basin is only about 39 inches. Evapotranspiration loss in this basin is at least 15 inches. The ground water in such instances may simply move through a permeable bed from recharge areas on one side of a divide to lower points of discharge on the other side or the water may move in any number of devious paths controlled by folds and faults. Figure 1-14 shows some hypothetical paths that ground water may take in the structurally complex mining area.

The alluvium in the larger valleys, such as Upper, Dry, Slug, Trail, Rasmussen, and Wooley Valleys, is the most accessible source of ground water, other than springs, in the mining areas. Most valleys with thick alluvium probably contain ground water that could be used as small domestic supplies. Wells that tap several lenses of the coarser material in the larger valleys should yield several hundred gallons of water per minute.

Water enters the alluvium from direct precipitation and from tributary streamflow from the surrounding ridges. Probably a considerable quantity enters the alluvium as underflow from smaller alluviated tributary valleys and from bedrock formations underlying the valleys.

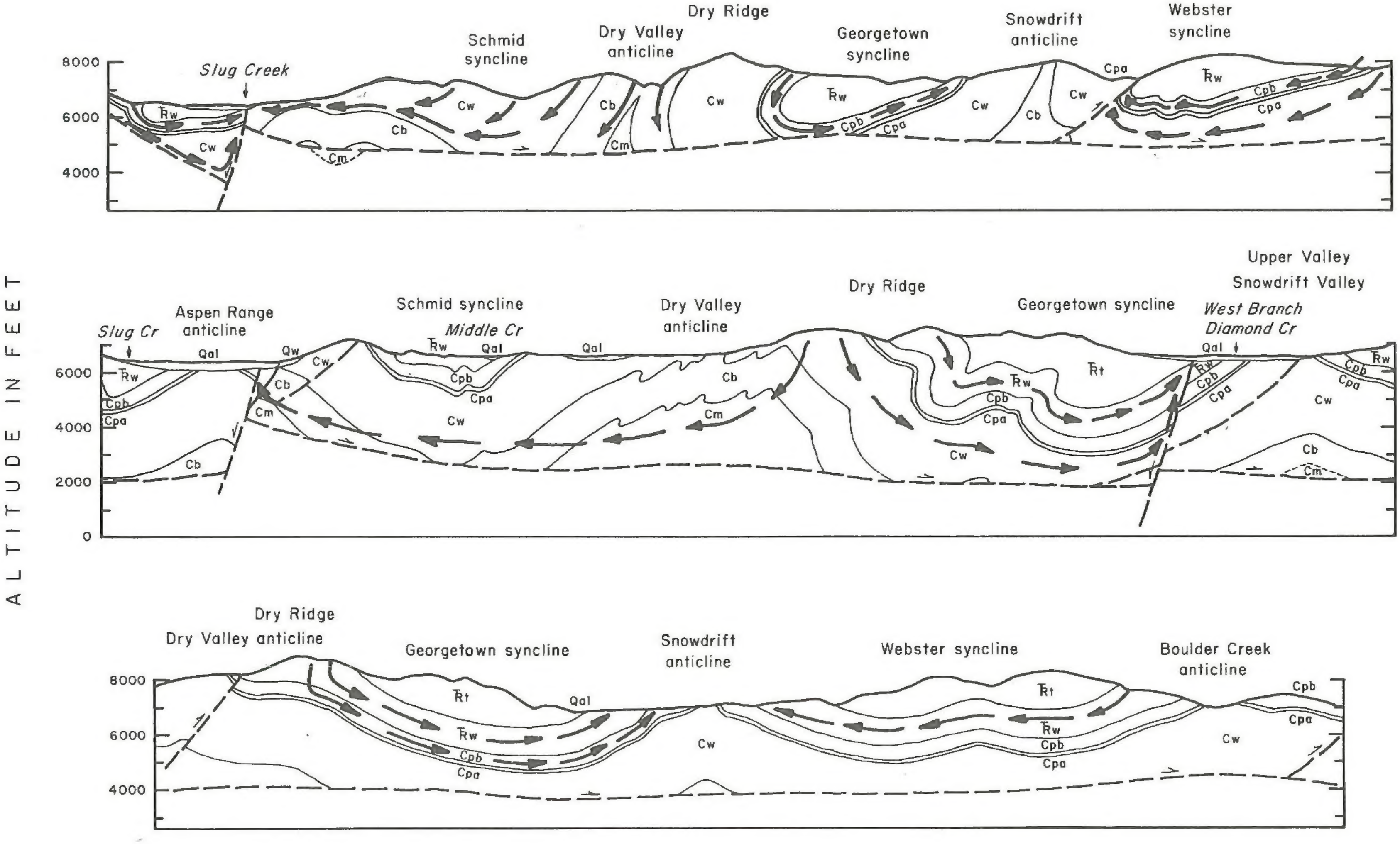

Figure 1-14.--Hypothetical ground-water flow paths (arrows) in complex geologic structures of study area. Adapted from Mansfield (1927).

Springs in both tributary and main valleys commonly issue from fault zones or from points near the contacts of permeable and impermeable formations. These springs contribute water which is recharged into the alluvium and which commonly reappears in the perennial reaches of streams as base flow. The ground water in the alluviated valleys moves, in general, toward the streams that drain the valleys and, thence, downgradient toward the valley mouths.

All proposed mining sites are in areas where virtually no ground-water has been developed and are far removed from urban areas. As of October 1974, only three "Well Logs and Report to the State Engineer of Idaho" had been filed from within the mining area. Latest information from the Idaho Department of Water Resources, indicates that only one application for the development of ground water was received in the years 1970 and 1971.

Springs and streams are the main sources of water for domestic and stock use in the mining area. Only two wells near proposed minesites--in the upper part of Dry Valley--are presently used for stock; there are no domestic wells near ongoing or proposed mines. Three wells for drinking water and sanitary use have been drilled by mining companies, two by Stauffer at the Wooley Valley mine, and one by Monsanto at the Ballard mine.

The occurrence of ground water at the proposed minesites was determined from both air and ground reconnaissances, geological maps, company drill-test data, submitted mining plans, published reports, and data from ongoing studies by the Idaho Bureau of Mines and Geology. Additional information on the occurrence of ground water was also obtained from environmental assessments accompanying many of the submitted mining plans. Data from drill holes were available for almost all proposed sites.

Considerable ground-water data for the Pocatello and Soda Springs areas were obtained from reports of the Idaho Department of Water Administration and the U.S. Geological Survey, from the Pocatello and Soda Springs water departments, and from records of the phosphate processing plants.

Most of the proposed mining sites are on ridges where ground water is negligible. The drill-test data indicate that ground water at proposed mining sites on steep hillsides and ridges occurs extremely erratically, and the quantity is too small to hamper the mining operations or interfere with general use of ground water in the area. Only two sites, the proposed Diamond Creek and Paris-Bloomington mines are likely to have significant ground-water problems. These are discussed in the appropriate sections.

The Conda-Soda Springs area (see fig. 1-15) includes the valley floor between Blackfoot River Reservoir on the north and Bear River on the south, and between the Aspen Range on the east and the Chesterfield Range and Soda Springs Hills on the west. It includes the valley area between Alexander and Soda Springs.

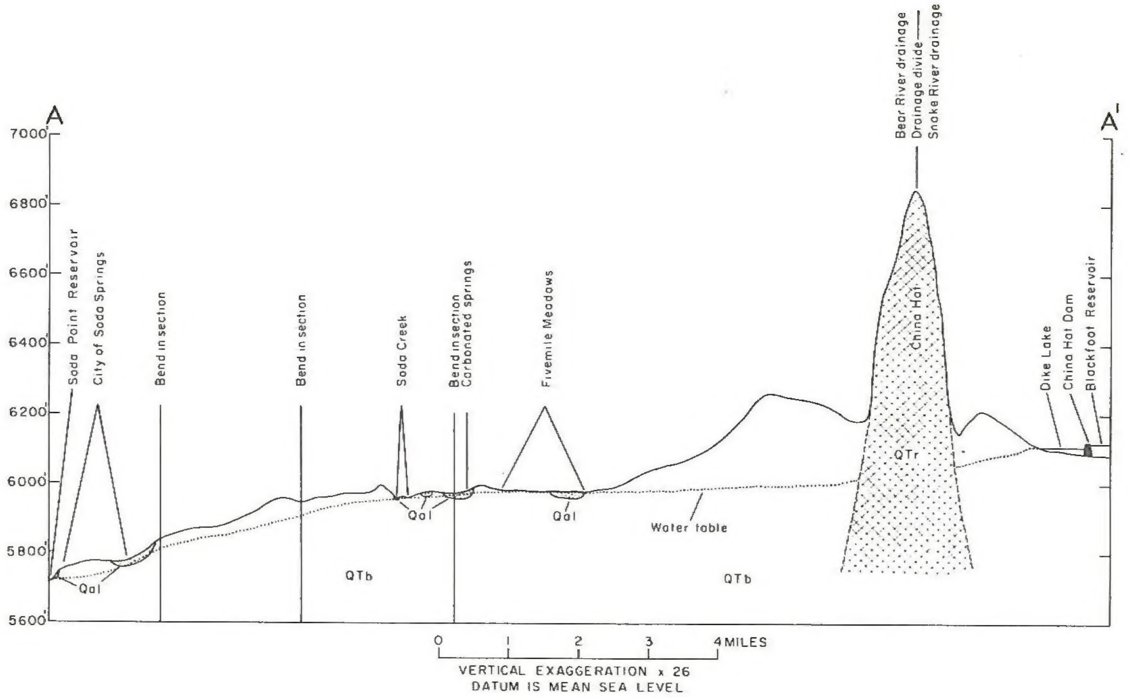

Figure 1-15.--Generalized hydrogeologic section along line A-A' of figure 1-16, Conda-Soda Springs area. Qtb, basalt; Qtr, rhyolite; Qal, alluvium. Adapted from Dion (1969).

Most of the valley floor is underlain by basaltic lava of the Blackfoot Lava Field, which extends northward beyond the Blackfoot River Reservoir and southward to the Bear River about 3 miles south of Soda Springs. Several extensive bodies of alluvium and tufa underlie the edges of the valley floor. The alluvium and tufa on the valley floor contain ground water, and a few small wells obtain water exclusively from these formations. However, these formations are not significant aquifers within the valley and are considered here as part of the lava aquifer. Springs like those now actively depositing tufa were active at various times and places in the Conda-Soda Springs area during the volcanic episodes in which the lava field developed. The source of the water emanating from the present springs is unknown, but a likely source seems to be numerous massive limestone and dolomite formations in the surrounding mountains. These formations are extensively faulted and fractured so that water can move through them, dissolving constituents of the rock minerals including carbon dioxide, which are common in the spring water. The water from most of the springs is a calcium bicarbonate or magnesium bicarbonate type, suitable for most purposes. However, the springs below the mouth of Sulphur Canyon discharge water of a calcium sulfate type that is unsuitable for domestic purposes.

The Blackfoot Lava Field developed when an ancient valley was progressively filled by a series of overlapping individual lava flows of varying thicknesses and extent. According to USGS data, the aggregate thickness of the flows in the deeper part of the valley is as much as 1,000 feet. The lava is pervasively fractured, and rubbly and cindery zones commonly occur between the individual beds, so the lava, in general, is a fair to very productive aquifer which contains water under unconfined, or water-table, conditions. Wells penetrating the lava to depths from 200 to 300 feet commonly yield from 500 to 3,500 gallons per minute, although some yield considerably less.

Water from rain, snowmelt, and irrigation enters the lava through permeable soil or fractures in the exposed lava; considerable quantities leak into the lava from Blackfoot River Reservoir and from the channel of the Blackfoot River in the 3-to-4 mile reach immediately upstream from the reservoir. Water also enters the lava as underflow from the surrounding hills and mountains and as discharge from large springs which are common in the area.

The general direction of ground-water movement in the lava, deduced from water levels (see fig. 1-16), is southward from Blackfoot River Reservoir and the Blackfoot River above the reservoir, past Soda Springs, and thence, southwestward toward the Bear River and Soda Point Reservoir. The regional water table is above the level of Soda Point Reservoir at the eastern end and below it at the western end, suggesting that ground water discharges into the eastern part and seeps from the western part of the reservoir.

Ground water leaves the lava as evapotranspiration, discharge from springs which feed Soda Creek and other smaller creeks, underflow to the Bear River and Soda Point Reservoir, underflow through the lava

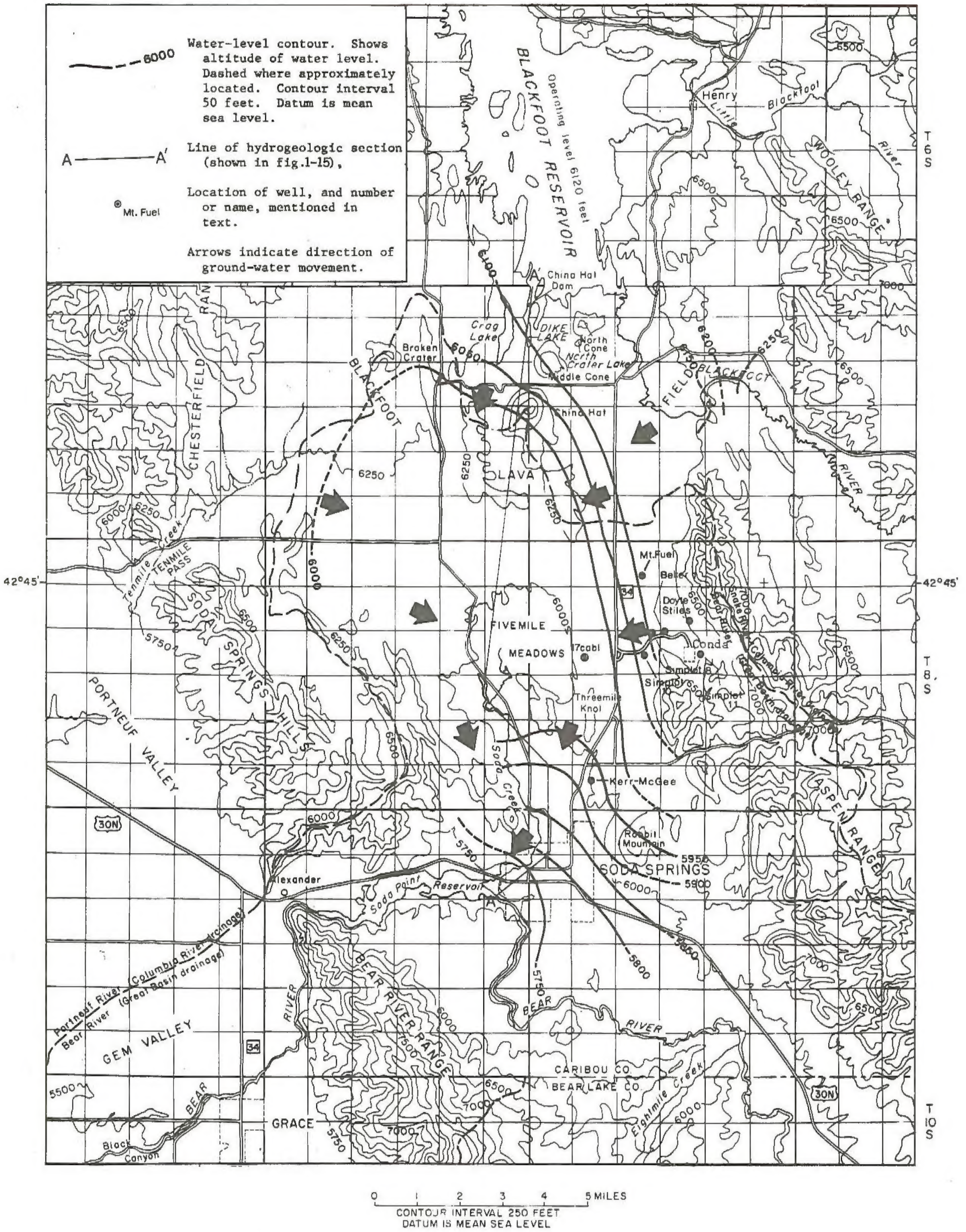

Figure 1-16.--Water-level contours in the Conda-Soda Springs area, spring 1969. Adapted from Dion (1974).

at Alexander, and pumpage from wells. Some probably leaves as underflow through Tenmile Pass, but this has not been documented.

The Idaho Department of Reclamation (Dion, 1969), now the Department of Water Resources, estimated that the Soda Creek drainage basin yields about 52 cfs (37,600 acre-feet per year), which is about 40 cfs (29,000 acre-feet per year) in excess of its expected yield. Dion attributed this excess yield to water leaking from Blackfoot River Reservoir and to water from springs which probably obtained it from areas outside the Soda Creek drainage basin. He concluded that much of this excess yield ultimately appears in the Bear River. In a discussion of the credibility of the results, the department emphasized that these figures are based on inadequate data and are, at best, only approximations. Nevertheless, the figures do indicate that perhaps as much as 75 percent of the yield of the Soda Creek drainage basin is derived from ground-water sources. Probably most of the ground water originates outside the drainage basin.

Ground water is used for beneficiating and processing phosphate ore in the plants north of Soda Springs and for municipal supplies for Soda Springs. Water used at the plants is pumped from wells; that used for the Soda Springs municipal supply is from springs. Ground water is also used in the area for irrigation and small domestic supplies.

The combined pumpage of ground water for the processing plants in the Conda-Soda Springs area is about 5.58 mgd or 6,250 acre-feet per year. Records of water levels in well 17cab1 since 1966 and comparisons with earlier USGS data indicate no long-term trend of lowered water levels in the Soda Creek drainage basin. In fact, the hydrograph indicates that water levels have risen about 3 feet since 1970.

The Pocatello area includes the flatlands adjacent to the Portneuf River between Pocatello and the American Falls Reservoir, as well as part of the Michaud Flats, which border the Portneuf on the west, and part of the Gibson Terrace, which borders the river on the east. The area is underlain by alluvium or alluvial-fan deposits deposited by the Snake and Portneuf Rivers. The alluvium is underlain at depths varying from about 100 to 400 feet by basalt and other types of volcanic rock. Both the alluvial sediments and volcanic rock are excellent aquifers. Water in these formations probably is largely unconfined. Wells in the alluvium within a radius of 5 miles north and northwest of Pocatello commonly have yields ranging from 1,000 to 3,000 gallons per minute with less than 100 feet of drawdown.

The alluvium receives water from direct precipitation and from underflow from the hills south and east of the flatlands. The general direction of ground-water movement is from the hills toward the Portneuf River, into which much of the ground water is discharged (fig. 1-17, reference 14). The combined discharge of springs between gaged sites at Pocatello and American Falls Reservoir is about 310 cfs, or about 224,000 acre-feet per year.

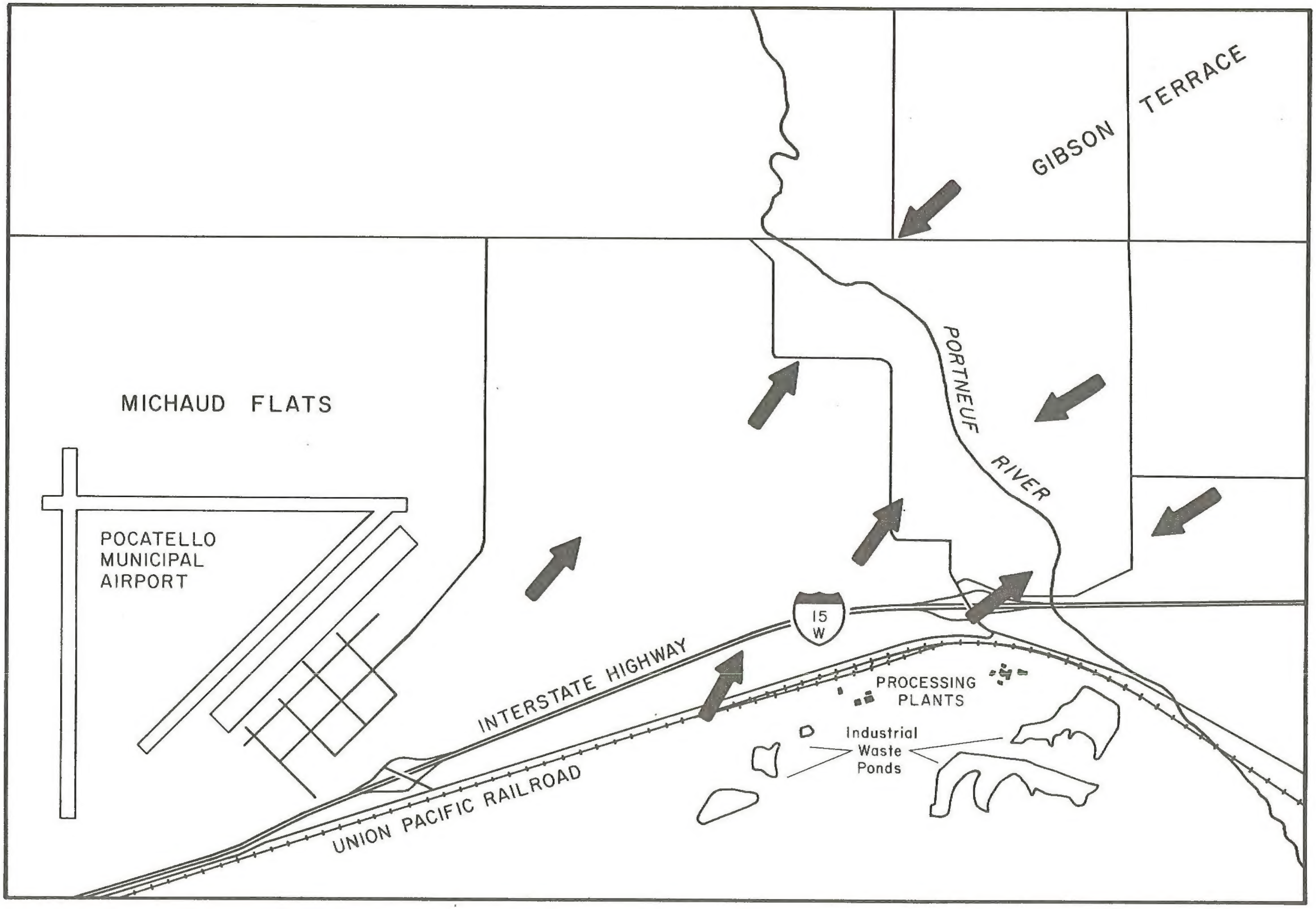

Figure 1-17.--Directions of ground-water flow (arrows) near FMC and Simplot processing plants northwest of Pocatello. Adapted from West and Kilburn (1963).

Ground water is used in the Pocatello area for municipal, industrial, irrigation, private residence, and stock supplies. The city of Pocatello obtains most of its municipal water from 14 wells within the city. In 1973, withdrawals from these wells averaged about 10 million gallons per day, or about 15 cfs (11,000 acre feet per year).

Data on withdrawals for irrigation, domestic, and stock use are not available. However, the USGS estimated that in 1963, 35,000 acre-feet per year was withdrawn from the Pocatello area, which includes the water withdrawn for municipal use.

In 1974, the phosphate-processing plants northwest of Pocatello withdrew about 7,500 gallons of water per minute (gpm) (12,100 acre-feet per year) from six wells on the plant properties, and discharged into the Portneuf River about 2,500 gallons of waste water per minute (4,030 acre-feet per year). Of this amount, the FMC plant withdrew about 3,500 gpm(5,650 acre-feet per year) and discharged 2,000 gpm (3,230 acre-feet per year); and the Simplot plant withdrew about 4,000 gpm (6,450 acre-feet per year) and discharged about 500 gpm (810 acre-feet per year). Due to improved conservation practices, the FMC plant projects its 1976 and future use at about 2,200 gpm (3,550 acre-feet per year), its discharge of waste at 1,100 gpm (1,775 acre-feet per year).

Withdrawals of this quantity of water have not caused any significant change of water levels. There has been no long-term lowering of water levels in the City of Pocatello wells, although during prolonged dry spells, according to the Pocatello Water Department, water levels have temporarily declined.

Little is known of ground-water conditions in the area between the Snake River Plain on the northwest and the Blackfoot River Reservoir and Grays Lake on the southeast. However, data from the USGS (West and Kilburn, 1963) and the Idaho Department of Reclamation (Norvitch and Larson, 1970) are generally applicable. The following discussion is largely an extrapolation of the information in these reports.

The Blackfoot Mountains and the Chesterfield Range dominate this area (hereafter referred to as the Blackfoot Mountains area) The higher parts of the mountains are formed of the same sequence of folded and faulted rocks of Paleozoic and Mesozoic age that form the mountains east of Soda Springs. However, a large parts of the mountains' flanks are formed of sedimentary rock of Tertiary age (Salt Lake Formation), and the surrounding flatlands and low foothills are formed of volcanic rock, slope wash, and alluvium.

Little is known about the water-bearing characteristics of these sedimentary rocks in the Blackfoot Mountains. However, where fractured, the limestone, dolomite, quartzite, and chert beds probably contain water in structurally and topographically favorable areas. The fractures in some of the more massive limestone and dolomite beds probably have been enlarged by solution, and where this has occurred, they will transmit large quantities of water to wells. The other rock types also probably contain water at one or more places, but the chances are poor for obtaining from these more than enough water for stock or small domestic use.

The areas of recharge and the direction of ground-water movement in these rocks depend largely on local physical characteristics and the structure of the rocks. Until detailed data on these factors are available, it is not possible to describe the ground-water flow paths in the Paleozoic and Mesozoic rocks in the Blackfoot Mountains area.

Some of the conglomerate and sandstone beds in the Salt Lake Formation of Tertiary age absorb and transmit water readily and are a good source of water in some areas. However, the distribution of these beds is erratic, in both vertical and horizontal directions, and wells drilled into this formation may or may not intercept enough permeable beds to sustain substantial yields.

The direction of ground-water movement in the Salt Lake Formation cannot be determined from presently available data. However, the Salt Lake laps against the mountains comprising rocks of Paleozoic and Mesozoic age. The ground water probably moves away from recharge areas in the high mountain areas toward points of discharge along Willow Creek, the Snake River, and the Portneuf River.

The volcanic rock is a major source of ground water in the Soda Springs area and in the Portneuf River drainage area. The yield of wells in the basalt commonly is between 1,000 and 3,000 gpm, but the magnitude of the yield depends on local permeability of the basalt at a particular site.

The alluvial deposits beneath the floodplains of the larger streams contain water; where these deposits are extensive and thick, they will supply moderate quantities of water. The water in most of these deposits is hydraulically continuous with the streamflow and has practically the same average gradient as the streams.

A considerable part of the base flow of the perennial streams in the Blackfoot Mountains area is from springs, which are common both in the mountainous areas and in the low areas near the streams' mouths. The discharge of these springs ranges from little more than seeps to several tens of gallons per minute, but accurate measurements of the discharge have not been made.

b. Water Quality

The area which includes the Conda-Soda Springs processing plants and existing and planned minesites, is drained by the Bear and Blackfoot Rivers and their tributaries. The processing area near Pocatello is drained by the Portneuf River. Several years of record, including rather complete chemical-quality data, are available for both the Bear and Blackfoot Rivers. There are considerable recent data for the Portneuf River and one of its tributaries, Marsh Creek. Prior to 1974, data for tributaries to the Bear and Blackfoot were meager and scattered. Since then, partial chemical analyses and discharge measurements have been made on a fairly intensive basis. Agencies involved in collection of analytical data include the Idaho Department of Health and Welfare, Division of Environment, the U.S. Geological Survey, and the U.S. Forest Service. In addition to these, some of the mining companies have been monitoring water-quality parameters for water of streams in the vicinities of existing or proposed minesites. These data are on file with the Task Force; the significant parameters are tabulated or summarized in this statement.

In this report, we have attempted to include pertinent water quality criteria as related to potentially toxic trace elements, radium-226 and the nutrients where available. For more complete criteria and guidelines for these parameters as well as others see the following publications. Water quality criteria, 1972, EPA-R3-73-033, March 1973; EPA interim primary drinking water standards, promulgated in June 1975; Idaho water quality standards and wastewater treatment requirements, June, 1973; EPA mineral mining and processing point source category: effluent guidelines and proposed standards; interim rule and notice of proposed rule making, June 10, 1976.

Ground-water data consist of analyses from springs and wells near the phosphate-processing areas at Pocatello and Conda-Soda Springs. Several additional analyses are available for springs and wells in the mining areas in the Bear River basin. Little other information on ground water in the mining area is available, except for what may be inferred from surface-water streams. The climate is semiarid and much, or most, of the surface-water flow comes from springs.

Environmental water-quality problems near the phosphate mines appear to differ from those near processing plants; accordingly, the areas are discussed separately.

Data on the surface-water quality of the Bear River at Soda Springs and Alexander and the Blackfoot River near Henry are available for several years. The means and ranges of concentrations of selected dissolved constituents, in parts per million, are shown below.

	Orthophosphate, as PO_4		Nitrate, as NO_3		Fluoride	
	Range	Mean	Range	Mean	Range	Mean
Bear River (Soda Springs)	0.07-0.23	0.13	0.2 -5.8	1.8	0.03-0.4	0.3
Bear River (Alexander)	.00- .18	.06	.09-2.7	1.2	.2- .4	.3
Blackfoot River (Henry)	--	--	.2 - .3	.3	.1- .2	.1

In these rivers, maximum fluoride concentrations are uniformly low (0.4 ppm), and the maximum phosphate concentration was 0.23 ppm.

The water in the streams tributary to the Bear River is generally similar to the ground water: calcium and magnesium are the ug/1 (micrograms per litre), while chromium, copper, and zinc were equal to or less than 10 ug/1. Other data obtained subsequent to that in table 1-11 shows the following ranges and averages in micrograms per liter for two measurements (May and September, 1975) at each of the sites (except for Maybe Creek) shown in table 1-11 (total of 10 measurements for each parameter).

	Range	Average
Arsenic	-	1
Cadmium	-	1
Chromium	1-14	3
Copper	1-21	7
Vanadium	1-71	23
Zinc	3-68	23
Selenium	1-8	(one value 8; All others 1)

These values including those for table 1-11 represents unfiltered and acidified samples and are doubtless higher than dissolved concentrations while not alarming for unfiltered samples are interesting in that that element is relatively concentrated in some rocks of the Phosphoria and its presence in the water suggests mobility of that element.

This is further suggested in analyses made on filtered (0.4 micrometre porosity) and acidified samples were made by the U.S. Geological Survey on a few stream-water and ground-water sources in December 1974 and March 1975. Concentrations of trace elements in surface-water sources, in micrograms per litre, are shown below: (values reported as "0" represent less than detectable concentrations)

Table 1-11.--Total concentrations of phosphate and nitrogen, in parts per million, and of selected trace elements, in parts per billion, in streams of study area during August and November 1974[1]

Stream	Latitude	Longitude	Phosphate as P Range	Phosphate as P Average	Kjeldahl nitrogen as N Range	Kjeldahl nitrogen as N Average
Stewart Creek[2]	42°41'28"	111°11'57"	0.06-.24	0.10	0.6-11	2.7
Diamond Creek[3]	42°41'30"	111°11'59"	.08-.14	.10	2.7-2.8	2.8
Mill Creek[4]	42°48'18"	111°18'35"	.05-.12	.08	.6-3.3	1.9
Angus Creek[5]	42°51'14"	111°23'45"	.06-.10	.07	.9-3.8	1.8
Sheep Creek[5]	42°51'47"	111°20'45"	.01-.06	.03	1.2-4.7	2.3
Maybe Creek[5]	42°44'45"	111°18'31"	.01-.25	.06	1.1-5.3	2.2
Blackfoot River[5]	42°37'37"	111°22'02"	.00-.05	.02	.9-2.2	1.4

Stream	Arsenic	Cadmium	Chromium	Copper	Vanadium	Zinc	Selenium
Stewart Creek	0	0	2	6	0	2	0
Diamond Creek	0	0	2	4	0	2	0
Mill Creek	0	0	6	4	0	3	0
Angus Creek	0	0	4	8	0	3	0
Sheep Creek	0	0	10	5	0	2	0
Maybe Creek	0	0	2	5	0	3	0
Blackfoot River	0	0	1	9	0	2	0

[1] From unpublished U.S. Forest Service data. Trace-element concentrations based on one analysis.

[2] Based on 10 analyses.

[3] Based on three analyses.

[4] Based on 12 analyses.

[5] Based on 11 analyses.

	Angus Creek, near Henry (Dec. 11, 1974)	Blackfoot River, above Angus Creek (Dec. 11, 1974)	Blackfoot River, near Henry (Dec. 12, 1974)	Blackfoot River, near Henry (Mar. 25, 1975)
Arsenic	0	0	0	0
Cadmium	0	0	1	0
Lead	0	1	1	0
Mercury	.1	.1	.9	.6
Molybdenum	0	0	0	0
Selenium	0	0	1	0
Vanadium	52	.9	1.5	.4
Zinc	4	3	3	10

Mercury concentrations, in Blackfoot River water near Henry, exceed the recommended levels (maximum 0.2 and average 0.05 micrograms per liter, EPA, 1973) for freshwater aquatic habitats, the other elements are not present at harmful levels, again, the concentration of vanadium in Angus Creek water is of interest for reason mentioned above.

Thus, on the basis of available data, concentrations of most trace metals are low in the water of the mining area. Theoretically, concentrations of such metals as cadmium, lead, and zinc would be expected to be low in true solution because the solubilities of their hydroxides and carbonates are very low and the solutions are near neutral pH. Another factor which lowers the concentrations further is that some metals exist in solution as positively charged cations which are adsorbed to usually negatively charged mineral surfaces. However, certain metals, such as vanadium and chromium, can exist in more than one oxidation state and can, under some circumstances, occur as anions, thereby giving the metals greater mobility in the aqueous environment. Another factor which can contribute to higher concentrations of metals than would be predicted from equilibrium solubility with crystalline solids is the formation of organo-metallic complexex. Such is more likely to occur in lake sediment which may contain considerable organic material. That environment may also promote the availability of potentially toxic elements associated with sediments by biochemical means. For example, a recent study (science, N. 192, p. 1130-1131) demonstrates the formation of volatile selenium compounds by micro-organisms in lake sediment through biological methylation.

Only limited data are available on turbidity of streams in the mining area. However, turbidity is often closely correlated with the concentration of fine sediments. Even though size distributions of sediment have not been made, the sediment concentrations that have been measured indicate that turbidity is low, except during high floods.

Although the suspended-sediment data are few, it is apparent that highest sediment concentrations occur during periods of high streamflow. Not only are hillslope sediments most readily eroded and sediment transported to stream channels during periods of concentrated flows, but during flood periods the streamflow has a high amount of energy available to pick up and transport sediment.

Most likely, the erosion of hillslopes throughout the year makes sediment available for transport at, to, or near the stream channels. Most of the sediment is transported downstream in the channels during the relatively few days of snowmelt peak flows occurring in the spring or during heavy rainfall events. Such high flows occur less than 5 percent of the time.

Sediment data collected by the Forest Service, for streams near existing or proposed phosphate mines, are summarized below. Suspended-sediment concentrations are in parts per million, and turbidity values, in Formazin turbidity units (F.T.U.). The data were collected between August 1 to December 1974 at the same sites noted in table 1-11.

Stream	Number of Measurements	Suspended sediment		Turbidity	
		Range	Average	Range	Average
Stewart Creek	13	0-91	9.5	0.2-2.5	0.7
Diamond Creek	3	1-6.0	3.0	.6-3.8	1.7
Mill Creek	12	0-7.0	2.8	.4-1.4	.8
Angus Creek	12	0-11	3.7	.9-3.0	1.7
Sheep Creek	12	0-5.0	1.0	.5-1.3	.8
Maybe Creek	12	0-21	10	.6-4.8	2.1
Blackfoot River	12	0-86	2.0 [a]	.5-7.7	1.6

[a] Does not include the one high value of 86 ppm

Additional data for these streams (except Stewart Creek) and for Kendall Creek were obtained by the Forest Service between April 1 and July 1975. Values for discharge, in cubic feet per second, and for sediment and turbidity are shown below.

Stream	Number of Measurements[1]	Discharge	Suspended sediment Range	Suspended sediment Average	Turbidity Range	Turbidity Average
Diamond Creek	9(5)	6.7-49	2-126	74	1.1-12	4.3
Mill Creek	18(14)	1.4-4.2	0-35	11	.3-2.7	1.3
Angus Creek	17(4)	4.2-2.6	0-86	18	.5-9.4	3.5
Sheep Creek	19(8)	8.6-39	1-167	34	.4-10	3.4
Maybe Creek	8	--	21-19,700	2,860	.3-300	45
Blackfoot River	22	84 -1,170	0-141	44	.4-9.6 a/	5.4 a/
Kendall Creek	16	--	0-59	16	.2-4.2	1.0

[1] Number of discharge measurements in parentheses if different from number of measurements of other parameters.

a/ Two values (22 and 73 FTU) were omitted as being probably an error on the basis of inconsistency with other parameters.

The sediment concentrations and turbidity values for streams other that Maybe Creek are not particularly high for spring-runoff conditions. For Maybe Creek, however, the site sampled was below an area severely disturbed by phosphate mining; the suspended-sediment concentrations, in parts per million, from April 2 to April 28, 1975, were: April 2, 21; April 7, 1,170; April 9, 19,700; April 14, 1,100; April 16, 518; April 21, 194; April 23, 118; and April 28, 33. According to EPA the higher values present significant problems for fisheries.

The available sediment data are most meaningful when they are correlated with hydrologic parameters and compared at streamflow events of constant frequency of occurrence. An analysis of the data by the U.S. Geological Survey has enabled the following tabulation.

Stream	Drainage area (mi^2)	Bankfull discharge (cfs)	Bankfull suspended sediment (ppm)
Upper Angus Creek	0.58	15	500
Mill Creek	1.95	35	411
Stewart Creek	2.73	40	336
Maybe Creek	3.50	45	408
Lower Angus Creek	3.70	60	169
Sheep Creek	8.76	75	268
Diamond Creek	9.93	50	123
Blackfoot River	152	900	48

The data appear to enable some regional generalizations. As drainage area increases, bankfull discharge increases from about 20 cfs at 0.7 square miles to about 600 cfs at 100 square miles (mi^2). Also as drainage area increases, the value of suspended-sediment concentration decreases from about 500 ppm at 1 mi^2 to about 200 ppm at 10 mi^2 to about 60 ppm at 100 mi^2. Downstream increases in discharge generally dilute sediment concentrations so that sediment is transported downstream without deposition in the channels. In isolated instances, tributaries may discharge more sediment into main channels than can be immediately transported, but subsequent main-channel high flows are adequate to maintain long-term equilibrium of stream grades.

It is important to note that at bankfull discharge, values of suspended-sediment concentration vary over about a 10-fold range. Thus at high flows, small tributary streams are likely to have higher values of suspended-sediment concentration than do larger streams. As discharge decreases, smaller streams clear more rapidly than do larger streams. At medium flows, most streams are likely to have about the same suspended-sediment concentration (roughly 50 ppm), and at low flows, the tributary streams may contain less suspended-sediment than main-stem streams.

Streamflows of bankfull discharge occur less than about 5 percent of the time. Other than the relatively few days associated with snowmelt peak streamflow, and the even fewer days associated with high flows due to heavy rainfall events, channels in the proposed mining area normally transport only little suspended sediment.

Computations of mean annual suspended-sediment concentration involve knowledge of flow durations as well as of sediment-transport characteristics. Flow-duration data are not available for locations of sediment data; however, approximations made by the U.S. Geological Survey, utilizing a regional flow-duration curve, indicate that the smaller, perennial streams in the proposed mining area have a weighted mean annual sediment concentration of about 150 ppm. However, this value should not be used indiscriminately in computations of sediment yield.

Because of the paucity of sediment data in the proposed mining area, data from two nearby regions were compared to the southeast Idaho data for verification. Data from south-central Idaho and from northwest Wyoming largely substantiate the trends indicated in the above discussion and allow greater reliance than would have been possible otherwise.

The chemical composition of solutions in waste ponds and effluents are of interest because potential water-quality problems originate from waste materials generated in the processing plants. Kinds of waste ponds associated with different types of processing operations include the following:

Type of plant	Type of pond
Washing-sizing	Beneficiating (tailings)
Fertilizer complex	Gypsum, cooling, water runoff
Elemental phosphorus	Evaporating, calcining

To illustrate the areal extent of some of the waste ponds, Beker Industries, Conda Operation, have two beneficiating ponds (about 38 acres each), an inactive gypsum pond (about 36 acres), and another gypsum pond with two sections of about 58 acres each (one of these for future use). They also have a cooling pond (about 36 acres) and a pond which collects overland runoff (4 to 5 acres).

At Beker's Conda plant, the gypsum and cooling ponds are sealed with membrane liners. The beneficiating and runoff ponds are not sealed.

Some data for ponds at the Beker Conda plant, provided by Idaho Department of Health and Welfare, Division of Environment, are summarized in table 1-12. The data show that the chemical compositions of the solutions in the ponds are quite variable. However, the concentration of fluoride was 55 ppm in the cooling pond, much higher than the concentrations in the beneficiating pond, which ranged from 3.4 to 5.2 ppm.

Table 1-12.--Summary of waste-solution composition, in parts per million, in Beker Industries' processing ponds in Conda-Soda Springs area, May and June 1973

	Beneficiating pond		Water runoff pond		Cooling pond		Gypsum pond	
Constituent	Average	Range	Average	Range	Average	Range	Average	Range
Nitrate	28	11-45	20	6-40	35	--	39	25-55
Phosphate	5.2	1.2-9.8	5.4	2-13	77	--	1,240	320-3,950
Fluoride	4.1	3.4-5.2	4.8	2.2-6.4	55	--	900	300-2,000
Ammonia as N	.95	.1-2.0	16	.2-108	16	--	28	.2-84
Arsenic	.06	.01-.12	.06	.01-.18	.02	--	.06	.01-.14

Source: Idaho Department of Health and Welfare, Division of Environment.

The runoff pond at Beker's Conda plant showed a wide range of concentrations. On May 3, 1973, the concentrations of sulfate, nitrate, and total Kjeldahl nitrogen in the runoff pond were 1,050, 40, and 100 ppm, respectively. On May 22, 1974, the concentrations of the same species were 114, 6.0, and 4.2 ppm. Kjeldahl nitrogen is a measure of ammonia plus organically bound nitrogen expressed as nitrogen (N). Several reactions can convert the bound N to inorganic species--ammonium (NH_4), nitrite (NO_2), or nitrate (NO_3). At the same time, nitrogen can be used by organisms at one or more states of oxidation.

The gypsum pond contained much higher concentrations of dissolved solids than did the other ponds. The main constituents of the phosphate mineral apatite are phosphate, fluoride, and calcium. These constituents, especially phosphate and fluoride, occurred in high concentrations in the gypsum pond, where the maximum values were 3,950 ppm and 2,000 ppm respectively. The gypsum pond contains waste solutions from the reaction of the phosphate rock with sulfuric acid, which dissolves the phosphate, fluoride, and calcium from the rock and releases several trace elements that occur in higher concentrations in the Phosphoria Formation than in most other rocks.

Listed below are the average concentrations of some of the rare elements reported for the phosphate rock member of the Phosphoria (see table 1-7), compared with the concentrations in a filtered solution of a "gyp water" outfall to a gypsum pond at Beker's Conda Plant. This represents waste solution from the reaction cited above, and illustrates the relatively high concentrations of those elements in the waste. Note that the concentrations in the phosphate rock are average values, with maximum reported values (table 1-7) being much higher. The sample of the outfall solution was collected on December 12, 1974 and analyzed by the U. S. Geological Survey.

Element	Concentration in Phosphate rock in ppm	Concentration in solution of outfall in micrograms/litre
Vanadium	800	17,000
Zinc	750	24,000
Arsenic	30	360
Selenium	30	9
Cadmium	90	2,500
Thallium	3	1,500
Uranium	90	11,500

Data available for the same trace elements (except thallium) in a beneficiating pond (Beker) for a sample collected on the same date follow. The concentrations of the elements in the solution are compared with standards or recommended limits for drinking water (U.S. Environmental Protection Agency (EPA), 1973; U.S. Public Health Service, 1962).

Element	Micrograms/ litre	Standard or recommendation (upper limit, micrograms/litre)	Use
Vanadium	300	100	Livestock drinking water
Zinc	140	5,000	Public supply
Arsenic	11	100	do.
Selenium	58	10	do.
Cadmium	10	10	do.
Thallium	-	None established	
Uranium	19	500-1,000 (See below)	Public supply

It should be pointed out that EPA's interim primary drinking water standards, promulgated on December 24, 1975, specify that arsenic in drinking water not exceed 50 micrograms per litre. The 1962 USPHS recommended limits for arsenic (10 micrograms per litre) were equaled or exceeded in all the waste ponds shown in table 1-12. Such concentrations particularly those in beneficiating ponds may suggest a potential for mobility of that element near mine dumps. In beneficiating waste ponds (slimes and tailings) the processes which release the dissolved constituents are in general physical and hence might be similar to processes encountered in mine-waste leaching. The value for uranium is suggested by The Division of Industrial Hygiene, Ontario (Canada) Department of Health, as quoted by Water Quality Criteria, California State Water Resources Board. Radium-226 measured on the outfall was 7.9 picocuries per litre; for the beneficiating ponds, 1.1 picocuries per litre. The limit recommended by the U.S. Public Health Service (1962) for drinking water is 3 picocuries per litre. Recommendations based on transient rates of intakes for radium-226 are discussed by EPA (1973). The standard of the Nuclear Regulatory Commission (formerly Atomic Energy Commission) for release to the unrestricted environment is 30 picocuries per litre, according to EPA. For a further discussion of radioactivity, see Chapter II-B-1-c, Mineral Industry.

The solutions in the gypsum ponds are in a restricted environment and normally would not find their way to surface-water streams. Furthermore, the gypsum ponds at Beker's Conda plant are sealed with membrane liners (polyethylene, butyl, or polyvinyl chloride). This is designed to avoid contamination of ground water.

Significant leakage from a gypsum pond might possibly contribute certain trace heavy metals to ground-water sources, but present data do not suggest this is occurring. However, waste solutions, such as those in gypsum pods are illustrative of changes in distribution relative to unmined conditions, of potentially hazardous elements.

The effect of redistribution of the naturally occurring trace elements, depending on the element involved, may be to concentrate it in solution or in one of the solid products or by-products or merely to physically scatter it as in the case of sediment erosion of mine wastes. In any event the overall effect is to make the elements more available to use by man and other organisms then they would be if the ore were left unmined. A complete inventory of products and wastes of the phosphate industry, with expected distribution of trace elements in each, is beyond the scope of this report nor is such possible on the basis of available information. However, a few generalizations can be made with respect to non-radiological elements and implications of such are scattered throughout this and some other sections on water quality.

With respect to the radiochemical elements, uranium, radium and thorium a recent study by EPA of phosphate rock mining and milling in Florida permits evaluation of the distribution of some of those species in various products, ranging from wastes and marketable phosphate-rock to more refined phosphate products. In general dissolved concentrations in solution, except for process solutions and certain waste solutions, will be insignificant. Particulate material, however, from tailings and slimes may contain pretty much the same concentrations as beneficiated rock and these particulates could find their way to streams and reservoirs. Phosphoric acid prepared by acidulating phosphate rock with sulfuric acid and ammonium phosphate prepared by reacting phosophoric acid with ammonia will contain little of the radium-226 but much of the uranium-238 originally present. Other products such as superphosphate and triplesuperphosphate will contain larger amounts of radium-226 and will have similar content of uranium-238, both relative to phosphoric acid. Most of the radium-226 present in the beneficiated rock will be retained in gypsum, the byproduct of the wet-process preparation of phosphoric acid.

Nitrate concentrations in each of the four ponds at Beker's Conda plant averaged from 20 to 39 ppm. The concentration in the unsealed beneficiating pond ranged from 11 to 45 ppm; in the runoff pond, from 6 to 40 ppm. Such concentrations may offer a potential source of nitrate that could reach the water table. Because nitrates are not appreciably adsorbed to soil particles and because nitrate concentrations in unaffected ground water in this area are probably less than about 2 ppm, percolation of nitrate into the ground water table should be detectable at considerable distances from the source.

Wells near Conda have had high nitrate since at least 1967; little earlier data are available. Although the source of the nitrate may be the phosphate industry, not enough definitive data are available to be certain. Sources of nitrate contamination in other parts of the United States have included agricultural practices and septic tanks. There are, however, very meager data that suggest that possibly some samples upgradient in the ground-water aquifer from the Beker plant are lower than those to the west and south. But the data, as indicated, are meager and inconclusive.

Well samples were collected and analyzed by the Idaho Division of Environment. These data are summarized for a few selected but critical parameters in table 1-13. Those wells sampled seven to nine times in 1973 showed large variations in concentrations of constituents.

For example, in Simplot well 8 (fig. 1-16), concentrations varied from 62 to 87 ppm for nitrate, from 13 to 22 ppm for phosphate. In 1974 and 1975, phosphate was 71 ppm. The following wells near Conda had high nitrate concentrations. Ranges in ppm as NO_3 are shown:

Well	Range
Beker 1	30-52
Beker 4	42-75
Simplot 8	62-87
Simplot 10	45-59
Doyle Stiles	40-60

The concentration sometimes exceeded that suggested by EPA as the upper limit (44 ppm as NO_3; 10 ppm as N) for the feeding of infants. Well 8S-42E-17cab1, a little over 1 mile west of the Beker plant, has had high nitrate concentrations at least since 1967, when it was 72 ppm. Seven analyses from this well, made in 1973, showed nitrate concentrations ranging from 45 to 80 ppm--not a significant increase since 1967.

Simplot well 11, several thousand feet east of Simplot wells 8 and 10, contained much less nitrate in 1973 (0.5 to 2.3 ppm). Water from the Beker Mountain Fuel well (8S-42E-4db), about 2 miles northeast of well 8S-42E-17cab1, contained only 0.3 ppm of nitrate when it was sampled by the U.S. Geological Survey on December 12, 1974. The Kerr-McGee well near the Monsanto plant north of Soda Springs also had relatively low nitrate concentrations in 1967 (2.6 ppm). Well 8S-42E-7bda1, about 1 mile northwest of well 8S-42E-17cab1, had low but still significant nitrate concentrations (6.4 ppm) when sampled in 1968. Water from the spring flowing into Fivemile Meadows, at the head of Soda Creek, had 7.1 ppm nitrate when it was sampled by the U.S. Geological Survey on December 10, 1974.

Table 1-13 and the unpublished data from the U.S. Geological Survey suggest that some wells around Conda occasionally have water containing fluoride in concentrations that exceed the maximum values for drinking water recommended by the U.S. Public Health Service in 1962. The upper limit, based on an average maximum daily air temperature of 55° F at Conda for the period 1956-65, is 1.5 ppm fluoride. EPA standards effective in 1976 permit 2.2 ppm. Water from Beker well 4 contained 4.2 ppm on April 19, 1973, but all six measurements made during the next 2 months had fluoride concentrations of less than 1 ppm. Water from J. R. Simplot well 10 contained 8.5 and 2.5 ppm fluoride on May 14 and May 29, 1973 respectively. Other concentrations, including one measured as recently as December 13, 1974, were well below the upper limit. Water from Beker well 5 contained 1.9 ppm fluoride on December 12, 1974.

Generally, however, fluoride concentrations in ground-water and surface-water sources throughout the study area are below recommended upper limits.

More conclusive indications that processing near Conda may be contributing certain constituents to ground water are the unusually high

Table 1-13 .--Summary of chemical data, in parts per million, for selected constituents of water in wells in Conda-Soda Springs area[1]

Well	No. of samples	Dates collected	Nitrate	Nitrite	Kjeldahl nitrogen	Ortho-phosphate	Fluoride
Beker no. 1	9	4/19/73-6/7/73	30-52	<0.001-1.6	2.1-11	2.4-5.7	[2]0.3-0.4
Beker no. 4	8	4/19/73-6/1/73	42-75	.11-4.4	7.2-103	1.3-26	.8-4.2
JRS no. 8	7	5/14/73-6/7/73	62-87	.005-.34	3.6-6.0	13-22	.9-1.2
JRS no. 10	7	5/14/73-6/7/73	45-59	.01-.3	2.4-4.8	5.5-10	.5-8.5
JRS no. 11	7	5/14/73-6/7/73	.5-2.3	<.001-.005	1.4-3.0	.16-2.4	.2-.3
Doyle Stiles	7	5/14/73-6/7/73	40-60	.001-.002	1.6-3.5	.16-.3	.2-.3
17cab1	1	6/15/67	72	--	--	.10	.3
Do.	7	5/14/73-6/7/73	45-80	.001-.003	2.1-3.7	.07-.23	[3]<.01-.4
Kerr McGee	1	12/26/67	2.6	--	--	.13	.1

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[1] Adapted from data from Idaho Dept. of Health and Welfare, Division of Environment

[2] Based on seven measurements; one value of 50.28 ppm omitted.

[3] The value "0.01" is probably an error; all other values ranged from 0.35 to 0.40 ppm.

phosphate values in some well-water samples. Listed below are ranges of 1973, and for three wells sampled in December 1974 and March 1975.

Source	Orthophosphate concentrations, in ppm as PO_4		
	Through 1973	December 1974	March 1975
Beker well 1	2.4 - 5.7	--	--
Beker well 4	1.3 -26	--	--
Simplot well 8	13 -22	71	71
Simplot well 10	5.5 -10	18	46
Simplot well 11	.16- 2.4	.06	--

The concentrations of phosphate in water from Beker Well 4 and Simplot Wells 8 and 10 are remarkably high. Normally, precipitation, absorption, and biochemical reactions maintain concentrations in most natural waters at considerably less than 1 ppm. The concentrations shown above suggest that lava aquifer materials present in the Conda area are very permeable and provide conduits for transmission of the water so that insufficient time and (or) insufficient reaction sites are available to lower the concentrations in the water of those wells. Such concentrations may not represent harmful levels for human consumption.

Certain trace elements were analyzed for the sample collected in December, 1974 and these are shown below.

Element	Simplot well 8	Simplot well 10	Simplot well 11
		1/ (micrograms per liter)	
Arsenic	42	-	2
Cadmium	0	-	0
Lead	1	-	2
Mercury	0.1	0.2	0.1
Molybdenum	5	-	7
Selenium	3	-	7
Vanadium	14	-	0
Zinc	6	6	30

1/ Values recorded as 0 are less than detectable concentrations.

The values for arsenic and vanadium although they are not high enough to be harmful and higher in Simplot well 8 which also has the highest phosphate concentration.

Determinations for radium-226 and uranium for samples collected in March or April 1975 show those elements to low.

	Simplot Well 8	Simplot Well 10	Simplot Well 11
Radium-226 (picocuries per liter)	0.15	0.15	0.17
Uranium (micrograms per liter)	.25	.56	3.2

According to monitoring data supplied by Monsanto to the Idaho Division of Environment, the Monsanto plant at Soda Springs discharged an average of 3.4 cfs per day of wastes during December 1974; the daily effluent contained 123 pounds of phosphorus (as P) and 21 pounds of fluoride.

The U.S. Geological Survey measured the discharge and chemically analyzed a sample of the effluent collected on December 11, 1974, from the Monsanto outfall. The Survey also measured selected parameters in the waters of Soda Creek above and below the outfall at Soda Springs but, unfortunately, did not measure below the outfall some of the trace elements examined in and above it. These analytical data are presented below.

	Soda Creek, above Monsanto outfall	Monsanto waste outfall	Soda Creek below Monsanto outfall
Instantaneous discharge (cfs)	81	9.0	74
Nitrate+Nitrite as NO_3 (ppm)	4.2	15	5.3
Orthophosphate as PO_4 (ppm)	.26	5.8	.9
Fluoride (ppm)	2.8	8.8	.9
Cadmium, dissolved (g/l)	0	2	--
Lead, dissolved (g/l)	2	2	--
Mercury, dissolved (g/l)	.1	.1	.2
Molybdenum, dissolved (g/l)	1	93	--
Selenium, dissolved (g/l)	2	31	--
Vanadium, dissolved (g/l)	4.0	20	--
Zinc, dissolved (g/l)	60	20	4

The Idaho Division of Environment measured various water quality parameters at four stations and Monsanto's effluent along Soda Creek on April 4, 1975. The preliminary data for only one set of measurements suggest that Monsanto's effluent, which consists of cooling water, was not significantly affecting the chemical quality of Soda Creek at the time sampled. These data, along with a single set of measurements of benthic invertebrate populations, are on file with the Division of Environment (Idaho). A summary of the population inventory is present below:

Location on Soda Creek	Number of Species	Number of Specimens
Above Hooper Spring	12	521
Between Hooper Springs & Monsanto outfall	5	93
Below Monsanto outfall	7	131
Below Soda Springs	4	-*

*Qualitative Sample

In general, the greater the number of species, the better is the stream quality. Not enough data are available yet to support the obvious implication (from the above data) that the benthic populations are being adversely affected by Hooper Spring. Subsequent work being undertaken by the Idaho Division of Environment should be completed near the end of 1976.

The water-quality discussion for the Pocatello phosphate-processing area deals with waste ponds, with effluents from processing plants and the Pocatello sewage-treatment plant, and with their relation to the Portneuf River and to ground water. Radioactivity considerations applicable to phosphate-processing areas are discussed briefly. These are further discussed in Chapter II-B-1-c.

Considerable chemical data are available from the Idaho Division of Environment for the Portneuf River at six sites, for a tributary (Marsh Creek) at one site, and for several sources of inflow to the Portneuf River. The sites on the river extend from about 10 miles above the City of Pocatello to about 8 miles below the city. In this reach, sampled sources of inflow to the river include the Union Pacific Railroad oil separation plant, the FMC elemental-phosphorus plant effluent, the J. R. Simplot fertilizer-plant effluent, effluent from the City of Pocatello sewage treatment plant, inflow from Batiste Springs, and effluent from Papoose Springs fish hatchery. In addition to the sampled sources, there is large inflow from ground-water springs, and probably seeps, which have not been accounted for. For example, for one day (August 20, 1974), the following estimations or measurements for discharge were made for two sites on the river and for inflow sources entering between those sites. The numbers prefixed by P denote stations discussed later.

Source	Discharge (cfs)	Remarks
Portneuf River at U.S. Gaging Station at about river mile 18	88	Instantaneous discharge measurement made Aug. 20, 1974 by USGS
(P-8) U.P.R.R. Oil Separation Plant	0.2	Based on average of 132,500 gallons per day for period Aug. 20, 1974 to Dec. 31, 1974, (Idaho Division of Environment)
(P-9) FMC elemental phosphorus plant	4	Based on average of 2.608 million gallons per day for period May to mid October, 1974 (USGS)
(P-10) Simplot Fertilizer plant	1.2	Based on average of 0.8 million gallons per day for period May to October, 1974 (USGS)
(P-11) Pocatello Sewage Treatment plant	8.5	Based on average of 5.5 million gallons per day for period Aug. 20, 1974 to Dec. 31, 1974 (Idaho Division of Environment)
(P-12) Batiste Spring	4.7	Instantaneous discharge made March 27, 1975 by USGS
(P-13) Papoose Springs Fish Hatchery	-	-
(P-7) Portneuf River at Michaud Pumping Station	270	Instantaneous discharge measurement made Aug. 20, 1974 by USGS

Although some of these data are instantaneous, (one for Batiste 7 months later) and others are average values, they may give a semi-quantitative estimate of relative flows. The increase in discharge between the two sites on the river was 182 cfs and the sum of the point sources of inflow identified above between the sites is only 18.5 cfs, leaving about 160 cfs unaccounted for. Much ground water is entering this short reach of the river (about 8 miles).

Selected chemical data are shown for sites on the Portneuf River and Marsh Creek designated P-1 through P-7 (table 1-14a). Also shown are selected data (table 1-14b) for the City of Pocatello sewage treatment plant (P-11) which discharges into the Portneuf River between

Table 1-14a.--Water-quality data for Portneuf River and Marsh Creek near Pocatello, Idaho.[1] Units are parts per million unless noted otherwise

Source[2]	(P-1)	(P-1)	(P-2)	(P-2)	(P-3)	(P-3)	(P-4)
Date of collection	8/20/74	8/22/74	8/20/74	8/22/74	8/20/74	8/22/74	8/20/74
Iron (Fe) (total)	$<$ 0.01	0.03	0.02	0.07	0.02	--	0.01
Sodium (Na)	30	28	47	45	37	38	39
Potassium (K)	6	6.5	8.5	8.7	7.4	8.8	7.5
Bicarbonate (HCO_3)	261	264	295	312	281	273	268
Sulfate (SO_4)	--	--	--	--	--	--	--
Chloride (Cl)	9.0	7.0	8.0	7.0	8.0	9.0	9.0
Fluoride (F)	.3	.2	.4	.5	.4	.4	.2
Nitrate (NO_3)	1.0	1.4	1.4	1.6	.8	1.2	.42
Total Kjeldahl nitrogen as N	2.7	2.1	2.6	3.2	4.2	2.1	2.9
Phosphate (PO_4)	.19	.06	.24	.38	.28	.37	.18
Dissolved solids	380	384	456	528	480	456	464
Specific conductance (micromhos @ 25° C)	540	530	610	640	610	570	610
pH	8.3	8.3	8.0	8.2	6.2	8.3	8.1
Water temperature ($^{\circ}C$)	14.4	13.5	14.0	13.5	15.5	13.5	16.0
Turbidity (J.T.U.)	37	40	42	47	45	--	42
Dissolved oxygen	--	7.1	12	--	13	--	14

[1] See footnote at end of table.
[2] See footnote at end of table.

Table 1-14a --Water-quality data for Portneuf River and Marsh Creek near Pocatello, Idaho[1]--Continued

Source[2]	(P-4)	(P-5)	(P-5)	(P-6)	(P-6)	(P-7)	(P-7)
Date of collection	8/22/74	8/20/74	8/22/74	8/20/74	8/22/74	8/20/74	8/22/74
Iron (Fe) (total)	0.11	0.01	0.08	<0.01	0.07	0.01	0.03
Sodium (Na)	31	43	32	38	38	39	33
Potassium (K)	8.5	11	7.6	7.1	8.0	5.4	7.4
Bicarbonate (HCO_3)	271	232	254	254	246	271	283
Sulfate (SO_4)	--	--	--	--	--	--	--
Chloride (Cl)	9.0	10	9.0	10	9.0	8.0	6.0
Fluoride (F)	.4	.1	.4	.3	.6	.6	.6
Nitrate (NO_3)	.71	.50	.76	.61	.77	5.4	5.6
Total Kjeldahl nitrogen as N	2.1	2.0	3.1	2.1	2.8	2.9	3.2
Phosphate (PO_4)	.37	.19	.12	.24	.12	.88	.86
Dissolved solids)	428	412	416	428	424	336	440
Specific conductance (micromhos @ 25° C)	560	510	540	550	540	570	590
pH	8.5	8.2	8.4	8.5	8.5	8.0	8.1
Water temperature (°C)	14.5	15.5	15.0	15.5	15.0	20.0	14.0
Turbidity (J.T.U.)	47	36	44	39	--	11	10
Dissolved oxygen	--	13	4.6	14	--	13	--

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[1] Data from Idaho Department of Health and Welfare, Division of Environment.

[2] P-1 Portneuf River above confluence with Marsh Creek.
P-2 Marsh Creek at mouth, above confluence with Portneuf River.
P-3 Portneuf River above Pocatello, at Ross Park Bridge, river mile 22.0.
P-4 Portneuf River at Main Street Bridge, river mile 16.8.
P-5 Portneuf River at river mile 15.7.
P-6 Portneuf River at river mile 14.25
P-7 Portneuf River at Michaud pumping station, river mile 10.0.

Table 1-14a .--Water-quality data for Portneuf River and Marsh Creek near Pocatello, Idaho[1]--Continued

Source [2]	(P-9)	(P-9)	(P-10)	(P-10)
Date of collection	8/20/74	8/22/74	8/20/74	8/22/74
Iron (Fe) (total)	0.03	0.06	0.08	2.9
Sodium (Na)	45	44	115	185
Potassium (K)	7.9	7.9	9.3	9.3
Bicarbonate (HCO_3)	210	203	232	203
Sulfate (SO_4)	--	--	--	--
Chloride (Cl)	58	76	84	70
Fluoride (F)	1.2	.8	6.7	8.6
Nitrate (NO_3)	2.3	1.7	7.4	7.3
Total Kjeldahl nitrogen as N	2.2	2.0	110	121
Phosphate (PO_4)	5.9	6.3	9.3	6.8
Dissolved solids	456	484	1,360	1,170
Specific conductance (micromhos @ 25° C)	600	670	2,100	2,600
pH	7.4	8.4	8.4	6.7
Water Temperature (°C)	30	--	19	24
Turbidity (J.T.U.)	7.0	8.0	12	18
Dissolved oxygen	8.8	--	12	3.5

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[1] Data from Idaho Department of Health and Welfare, Division of Environment.

[2] P-1 Portneuf River above confluence with Marsh Creek.
P-2 Marsh Creek at mouth, above confluence with Portneuf River.
P-3 Portneuf River above Pocatello, at Ross Park Bridge, river mile 22.0.
P-4 Portneuf River at Main Street Bridge, river mile 16.8.
P-5 Portneuf River at River mile 15.7.
P-6 Portneuf River at river mile 14.25.
P-7 Portneuf River at Michaud pumping station, river mile 10.0.
P-9 FMC elemental phosphorus plant waste outfall.
P-10 Simplot Fertilizer plant waste outfall.

Table 1-14b.--Effluent from sewage treatment plant at Pocatello.[1] Values parts per million unless stated otherwise

Date of collection	8/20/74	8/22/74
Iron (Fe)	0.19	0.10
Sodium (Na)	160	155
Potassium (K)	12	12
Bicarbonate (HCO_3)	410	376
Sulfate (SO_4)	--	--
Chloride (Cl)	10	25
Fluoride (F)	3.2	5.6
Nitrate (NO_3)	.38	<.01
Total Kjeldahl nitrogen as N	30	26
Phosphate (PO_4)	12	9.5
Total phosphate as PO_4	--	--
Boron (B)	--	--
Dissolved solids	872	916
Specific conductance (micromhos @ 25° C)	1,350	500
pH	8.7	7.7
Water temperature (°C)	20.0	20.0
Turbidity (J.T.U.)	36	17
Dissolved Oxygen	3.5	1.5

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[1] Data from Divisions of Environmental Services and Laboratories, Idaho Department of Health and Welfare.

sites P-6 and P-7. Detailed data for sites P-1 through P-13 in the reach of the Portneuf River are on file with the Idaho Division of Environment.

Data for selected parameters are summarized below. Units are parts per million.

	Ortho-phosphate (PO_4)		Total phosphorus (P)		Nitrate (NO_3)		Total Kjeldahl Nitrogen (N)	
Station	Range	Average	Range	Average	Range	Average	Range	Average
P-1	.01-.81	.17	.04-.43	.15	0.9-5.8	2.8	1.0-7.1	2.4
P-2	.01-2.7	.26	.01-.87	.24	1.2-6.0	4.5	1.2-5.0	2.5
P-3	.01-.57	.17	.02-.69	.22	.01-6.1	3.0	1.2-3.5	2.1
P-4	.01-3.7	.32	.02-.74	.21	.01-5.3	2.9	.01-4.5	2.3
P-8	.12-2.0	.90	.29-28.	1.7	.16-71.	26.	.38-38.	7.4
P-5	.01-4.9	.52	.01-.52	.21	.12-5.3	2.9	.01-4.9	2.4
P-9	1.7-11.	6.6	.90-9.8	4.3	1.4-14.	2.6	.70-22.	4.7
P-10	5.4-501	106.	3.2-170	39.	2.6-143.	23.	7.5-1,210	187
P-6	.01-4.9	.79	.01-1.9	.46	1.1-6.6	3.4	1.2-22.	4.1
P-11	.01-27	11.	3.6-24.	7.4	.01-15.	1.1	4.5-62.	34.
P-12	.35-7.5	2.2	.18-.86	.56	5.7-23.	10.	1.2-4.7	2.5
P-13	.27-7.6	1.8	.05-1.3	.49	4.2-14.	7.0	1.1-3.5	2.3
P-7	.25-6.6	1.1	.23-1.4	.48	3.1-11.	6.0	1.6-11.	2.9

For each of the four parameters above, from 15 to 27 determinations are represented. Note that in the above tabulation, orthophosphate is reported as PO_4 while total phosphate is reported as P (ppm P x 3.066 = ppm PO_4). Nitrate is reported as NO_3 and total Kjeldahl nitrogen as N (ppm N x 4.4268 = ppm NO_3). To determine the contribution of each source to the river site, the discharge of each source and of the river at the point of effluent must be known. Good values are available for discharge measurements at the U.S. Geological Survey gaging station about 1 mile above P-4 and at P-7 (U.S. Geological Survey). Discharge data for the effluent sources however, at the time the chemical quality samples were taken, have not been obtained. Only average values are known. Visual observation of the runoff channels for the effluent channels at FMC and Simplot suggest that the discharge, as expected, is highly variable. Preparation of a budget for the nutrients nitrogen and phosphorus for the river was not possible because of inadequate definition of discharge by discharge data and, more importantly, because of the large contribution of ground-water, which amounted to about 160 cfs on August 20, 1974 (see earlier) between about 1 mile above P-4 to P-7. The concentration of this ground water if represented by Batiste Spring (P-12), which contained an averages, of 2.2 ppm orthophosphate (PO_4), and 10 ppm nitrate (NO_3), and 2.5 ppm Kjeldahl nitrogen, appears to be a major contributor to the nutrient load. Assuming that the concentration of nitrogen in Batiste Spring is representative of all of the unaccounted-for ground-water inflow (about 160 cfs) to the river, the total nitrogen, based on the sum of the average for NO_3 and the average for total Kjeldahl nitrogen, based on the above tabulation, would be 4.8 ppm as N. This represents a total load for the ground-water inflow of 2.1 tons per day of N (or, if converted to NO_3, 9.3 tons per day). For comparison, the load at P-7, below the industrial complex, based on a discharge of 270 cfs (see earlier) and total N of 4.3 ppm as N, would be 3.1 tons per day as N or 14 tons per day as NO_3. Based on these necessarily rough approximation, the unaccounted-for ground water would be contributing about 66 percent of the total nitrogen load at site P-7.

The source of the nitrate here is unknown. The concentrations are high in wells all around the City of Pocatello. Data for selected wells mostly owned by the city and for wells in the Indian Hills subdivision, south of Pocatello, have considerable nitrate, as shown in the following table:

Well	Date	Dissolved solids	Calcium	Nitrate, as NO_3	Phosphate, as PO_4	Fluoride
80 Acres No. 1	4-27-65	360	104	6.6	--	0.05
Do	5-20-66	750	90	38	--	.32
Pocatello, No.3	1-4-61	320	58	5.3	0.02	.22
Do	8-31-66	440	72	27	.00	.53
Pocatello, No. 23	10-21-64	700	75	58	--	.35
Do	8-31-66	750	123	345	.12	.44

The nitrate concentrations in the wells range from 5.3 to 345 ppm as NO_3. Based on other data from the City of Pocatello, nitrate for 13 wells ranged from 3.6 to 17 ppm as NO_3 on July 26, 1974.

Although phosphate rock prosessing can be a source of nitrate, ground water movement around the Portneuf River (Figure 1-17) may preclude assignment of responsibility for high nitrate in the ground water there. For example, the nitrate in the well designated "80 acres No. 1" above is located south of the city of Pocatello which should be upgradient in the ground-water aquifer from the phosphate industrial plants. Other sources of nitrogen can result from certain agricultural practices and atmospheric contributions.

Perhaps more attributable to the industry are relatively high phosphate values (0.35 ot 7.5 ppm as PO_4) which occur in Batiste Springs (P-12, p. 141). However in this case as well as for nitrogen, further studies are needed to define the ground water regimen and to define all sources of those nutrients in the area.

Hardness in the ground water is very high, in many cases exceeding 300 ppm as calcium carbonate. "Very hard" water is defined as greater than 180 ppm as calcium carbonate. Many wells also have dissolved-solids contents exceeding 500 ppm, the limit recommended by the U.S. Public Health Service for drinking water.

In October and November 1972, the Idaho Division of Environment analyzed solutions in waste ponds at the FMC Corporation elemental-phosphorus plant near Pocatello. Concentrations of selected constituents, in parts per million, and pH's in the evaporating ponds are summarized below.

	Pond 1		Pond 7	
	Oct. 25, 1972	Nov. 21, 1972	Oct. 25, 1972	Nov. 21, 1972
Cadmium	3.4	1.7	1.4	0.56
Fluoride	440	640	680	618
Nitrate (as NO_3)	5	28	1.2	5.0
Ammonia (as N)	35	48	22	41
Phosphate (as PO_4)	106	320	.16	385
Molybdenum	--	--	--	.02
Zinc	92	38	40	25
Arsenic	22	6.6	17	4.4
pH	7.3	8.9	7.9	7.6
Vanadium	--	.02	--	.01

Concentrations and pHes for a calciner ponds at FMC were as follows:

	Oct. 25, 1972	Nov. 21, 1972
Cadmium	0.46	0.23
Fluoride	103	30
Nitrate (as NO_3)	12	10
Ammonia (as N)	45	9.2
Phosphate (as PO_4)	12	103
Molybdenum	--	.10
Zinc	1.7	.81
Arsenic	4.4	2.6
pH	3.2	6.4
Vanadium	--	.02

The concentrations of all of the above constituents are relatively high.

Data also provided by the Idaho Division of Environment suggest a causative relationship between arsenic in some phosphate-industry ponds near Pocatello and nearby wells. This suggests that arsenic may be somewhat mobile in the underground environment. Concentrations of arsenic in water of the wells occasionally exceed 0.05 ppm the limit according to EPA's interim primary drinking water standard regulation promulgated on December 24, 1975. Another potentially toxic substance, cadmium, was found to exceed 0.01 ppm (EPA interim drinking water standard) in water from several wells near the processing plants at Pocatello, The maximum value, observed in the data available from the Idaho Division of Environment was 0.03 ppm cadmium.

Analytical measurements for trace elements in ground water also suggest that those constituents are generally low, even in samples from areas near processing plants. Some concentrations, in micrograms per litre, from unpublished data of the U.S. Geological Survey are as follows:

	Spring Fivemile Meadows (Dec. 10, 1974)	Beker Mountain Fuel well (Dec. 12, 1974)	Beker well 5, near Conda (Dec. 12, 1974)	Simplot well 8, Conda (Dec. 13, 1974)
Arsenic	1	--	1	42
Cadmium	0	--	0	0
Lead	1	--	1	1
Mercury	.1	.3	.1	.1
Molybdenum	0	--	8	5
Selenium	1	--	2	3
Vanadium	.9	--	5.6	14
Zinc	4	9	5	6

Note: "0" values represent less than detectable amounts

The parameters listed above were measured also for water from Simplot well 11 and well 8S-42E-17cab1, both of which are near Conda, and from Batiste Springs, west of Pocatello; all showed similar low concentrations of trace elements. Arsenic in Simplot well 8 was approaching the 0.05 limit cited above. Water from a well at the Pocatello Airport contained 1,000 μg/l zinc, which, according to the U.S. Public Health Service, is not a harmful level for human consumption. That value, however, could represent contamination during sampling.

Because thallium is a potentially toxic element relatively concentrated in the Phosphoria (table 1-7), values for that parameter were obtained by the U. S. Geological Survey.

Source	Thallium (micrograms per liter)
Pocatello Airport (well)	0.2
Chubbuck City (well)	.06
Becker Mountain Fuel well	.1
Becker well 5	.1
Simplot well 11	.05
Blackfoot River above reservoir	.1

The above are for samples collected in December 1974. The following sources were sampled in March of 1975 showed less than the detection limit of 0.05 micrograms per liter of thallium: Portneuf River near processing plants (Pocatello), Portneuf River at Syphon Road, Batiste Springs (Pocatello), Blackfoot River above reservoir, and five snow samples near Pocatello and Conda. One snow sample near the Monsanto Power station near Soda Springs showed 0.1 microgram thallium per liter. Although no established criteria for safe thallium concentrations were found, the concentrations observed are not expected to be harmful.

Also of environmental concern is the question of whether the leaching of phosphate mine-waste dumps would contribute significant concentrations of heavy trace metals and nutrients to ground water and surface water. Almost no data are available, but one water sample was collected from a seep from Stauffer's Wooley Valley mine, about 14 miles northeast of Soda Springs, where the dump is a mixture of old and new workings. Unpublished data from the U.S. Geological Survey for a few selected constituents analyzed on a field-filtered (0.45 micrometre pore size) and field-acidified sample revealed the presence of 2 ug/l cadmium, 1 ug/l copper, 10 ug/l lead, 64 ug/l zinc, 2.8 ppm nitrate (as NO_3), and 0.07 ppm orthophosphate (as PO_4). These concentrations are not high, considering the proximity to the waste dump, and they are not appreciably higher than those in most water sources in the study area.

To further evaluate the possible impact of mine wastes on water quality the following laboratory experiments were conducted by the U.S. Geological Survey. A 21-pound composite of representative samples of ores from the Conda, Maybe Canyon, and Henry mines was ground and sized and 1,200 gram portion of 100 mesh material was mixed with 1,200 milliliters of filtered Blackfoot River water collected at a site between Blackfoot Narrows and the mouth of Angus Creek. This mixture was rotated in a ball mill for 48 hours. The runs were made in duplicate as were also runs using deionized water instead of Blackfoot River water.

The slurries were centrifuged at the end of 48 hours, and the solutions (leachates) decanted and filtered through 0.45 um membrane. Analytical data for trace elements and nutrients dissolved in the leachates as well as the river water (before leaching) are shown below. Results are in micrograms per liter unless other wise indicated. Zero values mean that the concentrations were less than the detection limits (1 microgram per liter unless other wise indicated).

PARAMETER	RIVER WATER	LEACHATE DEMINERALIZED WATER No. 1	LEACHATE DEMINERALIZED WATER No. 2	LEACHATE RIVER WATER No. 3	LEACHATE RIVER WATER No. 4
Antimony	0	0	0	2	1
Arsenic	0	7	11	1	7
Barium 1/	0	0	0	0	0
Boron	20	190	180	210	220
Cadmium	0	5	6	5	8
Chromium 2/	0	0	0	0	0
Lead	0	0	0	0	0
Mercury	0	0	0	0	0
Nitrate (NO_3, mg/l)	.04	1.0	.47	.46	.79
Nitnte (NO_2, mg/l)	.00	.10	.08	.12	.10
Phosphate (PO_4, mg/l)	.02	.32	.32	.36	.36
Selenium	0	16	16	18	19
Silver	0	0	0	0	0
Strontium (mgl/)	.20	.15	.16	.17	.18
Thallium 3/	0	0	0	0	0
Uranium	0.4	4.7	4.6	5.3	4.9
Vanadium	1.1	650	580	590	610
Zinc 2/	0	0	10	0	10
Fluoride (mg/l)	.08	2.1	2.1	2.2	2.0
Radium-226 (picocuries/l)	0.7	4/ 2.1	.7	.5	.5

1/ Detection limit, 100 micrograms per liter.
2/ The detection limit for the method used here was 1000 micrograms per liter.
3/ Detection limit 10 micrograms per liter.
4/ Possible analytical error.

It is noted that selenium in the leachates exceeds the limit for drinking water (10 micrograms per liter) promulgated by EPA, and cadmium is approaching the limit which is also 10 micrograms per liter. The concentrations observed for vanadium exceeds the upper limit recommended for livestock drinking water (100 micrograms per liter, EPA, 1973). Also fluoride concentrations are somewhat in excess of optimal concentrations for prevention of human dental caries.

The values for uranium are not high. One of the values for radium (2.1 picocuries/liter) is high enough to require monitoring (EPA), however the fact that three others leachates show less than 1 picocuries/liter suggests possible analytical error for the higher value.

Because of experimental conditions, the concentrations of some constituents shown above may possibly be higher than one would expect in an actual in-place mine-waste leaching situation. The surface area to liquid ratio was very high and perhaps energy input by the ball mill treatment could conceivably cause some dissolved constituents to be present at metastablly higher concentrations. The data from the experiments do appear to confirm the expected low solubility of many of the potentially toxic elements which are relatively enriched in the phosphate rock (see table 1-7).

Results of similar leaching experiments from tailings slimes, and settling pond sediments representative spoil materials, made for Alumet since the draft statement, are comparable to those shown above. Their data indicate that in tailings slime supermatant, arsenic was 8 micrograms per liter (ug/l); cadmium, 6 ug/l; molybdenum 340 ug/l; vanadium 900 ug/l and zinc 130 ug/l.

The following considerations also appear valid for evaluating probable impacts caused by leaching of mine wastes to both ground and surface waters. The minerals in the phosphoria which are host to the trace elements are low in solubility. This is inferred from solubility considerations and from the fact that major constituents in streams affected by sediments from a presently operating mine are not significantly greater than in areas not impacted by such sediments. For example at Maybe Creek above and below a sediment pond failure, the following dissolved solids data reflecting major constituents were obtained

Date (1975)	Above pond failure: Suspended sediment	Above pond failure: Dissolved solids	Below pond failure: Suspended sediment	Below pond failure: Dissolved solids
	(parts per million)			
April 30	16	235	219	233
May 5	4	240	346	235
9	24	220	248	238
13	6	230	1,250	230
19	37	215	8,040	195
29	45	235	1,330	225
June 2	18	205	278	225
9	130	200	1,280	215

According to the Forest Service, there is very little increment in stream discharge between the site sampled above the pond failure and the site sampled below the failure. Therefore the lack of significant differences for dissolved solids concentrations between the two sampled sites, imply that at least the rate of dissolution (if not the solubility) of host minerals is low. In addition to these considerations, the trace heavy metals contained in the host minerals are in many cases subject to solubility controls imposed by hydroxides and carbonates of the metals themselves. Many of these tend to be very insoluble, hence by inference the aqueous concentrations of most heavy metals which form cations are likely to be very low. However, sediment derived from mine waste is likely to be enriched in the potentially toxic elements and their low solubility does not necessarily preclude biochemical processes which may make them available to living organisms in streams and particularly impounded water bodies.

Radioactive species must also be considered in the Pocatello area. As mentioned earlier, gypsum, a byproduct in the preparation of phosphoric acid, contains radium. On the basis of a recent EPA study related to the milling of Florida phosphate rock most of the radium-226 present (in the marketable rock) is retained in the gypsum during the wet process preparation of phosphoric acid. Large stockpiles of gypsum are present on the grounds of the J. R. Simplot Company at Pocatello. In 1973, the U.S. Environmental Protection Agency (1974) reported radium concentrations in the gypsum, phosphate-rock ore, and waste outfalls at Pocatello, as shown below.

Material	Company	Radium concentration
Gypsum	Simplot	16 picocuries per gram gypsum
Ore	Simplot	33 picocuries per gram ore
Ore	FMC	30 picocuries per gram ore
Outfall	Simplot-1	.14 picocuries per litre
Outfall	Simplot-2	.58 picocuries per litre
Outfall	FMC	.06 picocuries per litre

The limit recommended by the U.S. Public Health Service for radium-226 in drinking water is 3 picocuries per litre; the standard of the Nuclear Regulatory Commission (formerly Atomic Energy Commission) for release of radium-226 to an unrestricted environment is 30 picocuries per litre, according to EPA. The effluent outfalls from both Simplot and FMC at the time sampled were well within suggested limits for drinking water.

Insufficient data are available to determine whether the radium from the ore or gypsum are reaching the ground water by leaching from processing-plant areas. However, a few measurements in the Soda Springs--Conda area and the Pocatello processing-plant area indicate that significant amounts of radium-226 are not reaching the sources sampled. Data for radium-226 (in picocuries/litre) and uranium (in micrograms/litre) obtained by the U.S. Geological Survey in December 1974 and March 1975 are as follows:

	Processing area	Radium-226	Uranium
Batiste Springs	Pocatello	0.07	1.7
Simplot well 8	Conda	.15	.25
Simplot well 10	Conda	.15	.56
Well 8S-42E-17cab 1	Conda	.03	1.4
Formation Springs	Conda	1.69	1.3

These values are not unusually high, however, the value for radium in Formation Springs should be further monitored, in accordance with recommendations of EPA.

Data from 17 wells and springs in the Bear River basin show nitrates ranging from 0.2 to 24 ppm as NO_3. Fluoride ranges from 0 to 2.3 ppm but generally is less than 0.3 ppm. Seven available measurements for phosphate range from 0.02 to 3.8 ppm as PO_4.

Alkalinity is greater than 1,000 ppm as HCO_3 in several springs, suggesting an abundant source of carbon dioxide in the water, a characteristic wellknown for this area.

The City of Soda Springs obtains its water from springs east and northeast of the city. Formation Springs, one of the main sources of municipal supply; spring-fed Ledge Creek; Hooper Springs, near Soda Springs; and a spring at the head of Fivemile Meadows show calcium ranges from 100 to 259 ppm; magnesium, from 35 to 70 ppm. These concentrations account for the hardness of the water.

Little is known about ground-water composition in the mining area east and north of the Conda-Soda Springs area. However, it is inferred from analyses of surface-water sources, which are largely spring fed during low-flow periods, that ground-water characteristics are similar to those described above.

The generally high concentrations of calcium and combined carbon dioxide in the ground water of the area indicate that much of the water is at or near saturation with respect to the calcium carbonate minerals calcite or aragonite. This means that the water could not dissolve significantly more calcium carbonate from such rocks as limestone. Some springs in the mining area precipitate calcium carbonate as travertine. Precipitation occurs when ground water approaches the surface and loses carbon dioxide, causing the water to become supersaturated with calcite or aragonite, some of which precipitates from solution.

Apatite, the principal phosphate mineral, contains calcium, phosphate, and fluoride ions. The pH of the water (about 6.5 to 8.5) and the relatively high concentrations of calcium in the water of the study area appear to limit the concentrations of fluoride and phosphate ions in solution.

Very few water samples in the study area have fluoride concentrations that exceed the upper limits recommended by the U.S. Public Health Service for drinking water. On the basis of average daily maximum air temperatures, those limits are 1.3 ppm for Pocatello and 1.5 ppm for Conda.

In summary, although the data for the study area are rather meager, the following conclusions seem appropriate.

Except in a few cases, the quality of the water resources has not been greatly degraded by phosphate mining and ore processing. According to the Forest Service, notable recent exceptions were discharge of mining machinery waste oil products to Angus Creek and the failure of the sediment retention pond on Maybe Creek. Most streams in the area support good fisheries, probably reflecting, in part, the abundant but hitherto not excessive supply of nutrients that occur in minerals of the Phosphoria and are probably released by disturbing the deposits.

The high concentrations of nitrate and phosphate near Conda suggests but may not prove contamination of ground water in that area by the phosphate rock industry. At Pocatello, other sources of nitrate appear likely and the source of that nutrient here is more obscure. It is possible, however, that the phosphate concentrations in Batiste Springs are, at least in part, attributable to the phosphate industry near Pocatello; but more information is needed as suggested earlier.

Although the nutrients nitrogen and phosphorus are possibly being released, the limited available data do not indicate that toxic elements, such as arsenic, cadmium, chromium, molybdenum, selenium, thallium, vanadium, and zinc, are present in significant quantities in either ground water or surface water.

Cadmium and arsenic were found to exceed the EPA interim drinking water standards for some wells in the vicinity of processing plants near Pocatello.

Concentrations of mercury, which among other potentially toxic metals (see table 1-7) is enriched in the Phosphoria sediments was found to exceed EPA's recommendation for fresh water aquatic habitat. Such occurred, however, in only two samples (p. 1-124) and more data are needed to verify these data. However, almost no information is available about the distribution of these elements on suspended material in surface water. Erosion processes acting on mine dumps and pits could conceivably carry trace elements into lakes and impoundments with possible deleterious impacts over the long term.

Concentrations of radium-226 dissolved in water were not generally significant in the few determinations made. The one significant occurrence in the water at Formation Springs (1.69 picocuries per litre), where radium should be monitored according to EPA recommendations, cannot be necessarily attributed to phosphate mining because the spring reportedly is near a faulted area.

Besides possible contamination of ground water by nutrients near processing-plant areas, erosion products from mine wastes constitute the greatest potential source of water degradation due to existing operations. Of particular concern is the suspended material in streams and its effect on biological mechanisms.

The Idaho Division of Environment is presently conducting intensive surveys of chemical quality and benthic populations for biological assessments of stream quality. The study of benthic populations will utilize species diversity as an indicator of pollution. The surveys either underway or about to start as of November, 1975 include the following streams:

Stream	Number of Stations
Upper Blackfoot River Diamond Creek Lanes Creek	5
Portneuf River (upper)	7
Portneuf River (lower)	14
Marsh Creek	7
Bloomington Creek	4
Georgetown Creek	6
Cub River	6
Bear River	12

Monitoring will continue for about 12 months. In addition to the above studies, the Idaho Division of Environment plans to measure chlorophyl-A, oxygen, temperature profiles, and nutrients at 5 stations on the Blackfoot Reservoir. Although some samples have been taken (as of January 1976), they have not been analyzed and no data are available.

c. Water Use

The Idaho Department of Water Resources is responsible for identifying and administering the use of the water resources of the State. This includes, among other functions, processing and recording surface-water and ground-water rights, distribution of the State's water in accordance with existing rights, supervision of water-well drilling and dam safety, gathering information regarding water use for the district courts of the State for water-rights adjudication, collecting basic data regarding the State's water resources, regulation of injection wells and waste disposal, and protection of stream channels.

Generally, a right to use water may be developed on any water source within the State that is, at the time the right is initiated, not fully appropriated and used by other water users.

The right to use waters in Idaho is limited and regulated by the laws contained in the Idaho Code. The Department of Water Resources is responsible for permit and licensing systems which control beneficial use of Idaho's waters, and the future conservation and development of waters through planning. A right to use water for phosphate mining may be developed on any public water source which is not fully appropriated and used by other water users. The so-called Federal "reserved right" doctrine would not be applicable to water use for phosphate mining.

In several surface streams, water supplies are limited, and any new water rights would be for water available only during early summer or during high flood flows; these include the Portneuf, Blackfoot, and Bear Rivers. Several ground-water basins within the State have been developed to the extent that no new rights can be initiated, but none of these are now in the study area. In other localized areas, wells are restricted or permits carry special conditions to make sure that they do not interfere with established surface-water or ground-water rights. Each new application is reviewed to see if it affects other rights, but this too does not now apply to the study area.

The Bear River Compact, ratified in 1955, provides for the apportionment of waters of the Bear River basin between the States of Idaho, Utah, and Wyoming. All the waters of this basin that are apportioned to Idaho have been allocated except for a part of the high flood flows.

According to the Utah Division of Water Resources, it does not appear that the mines and plants located in the Bear River drainage will have any great effect on the flow of the streams of the Utah border, except for their use of water under Idaho's entitlement under the revised compact. The Utah Division of Water Resources also states that facilities now in existance or in planning along the Bear River will adequately contain any increased sediment yield.

A summary of the undated statement of the Idaho Department of Water Resources regarding constitutional and statutory water law related to mining follows:

1. The necessary use of lands ... for the drainage of mines ... is declared to be a public use and is subject to the regulation and control of the State. (This law is a part of the Idaho Constitutional Right of Eminent Domain).

2. The right to divert and appropriate the unappropriated waters of any natural stream to beneficial uses shall never be denied, except that the State may regulate and limit the use thereof for power purposes. Priority of appropriation shall give the better right as between those using the water, but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall (subject to such limitations as may be prescribed by law) have the preference over those claiming for any other purpose; and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes. And in any organized mining district, those using the water for mining purposes or milling purposes connected with mining shall have preference over those using the same for manufacturing or agricultural purposes.

The Bear River and the tributaries of the Blackfoot and Snake Rivers that drain the study area fill water-supply needs that are important to the economy of both the region and the surrounding areas. Domestic, municipal, and industrial needs are served principally from ground water.

According to the Idaho Department of Water Resources, the flow of the Bear River Basin is fully appropriated during average or below average years. However recent proposed amendments to the Bear River compact would insure that additional water could be developed but would require construction of storage facilities or well fields. Water requirements as a result of phosphate development, including that which may be required for cooling of power facilities, could require a significant portion of any remaining available developable water in the Bear River drainage in Idaho.

Table 1-15 shows the quantity of water presently used for municipal, industrial, and agricultural supplies in the eight counties in the study area.

More than 57,000 acres in Bear Lake County and 58,000 acres in Caribou County are irrigated, and nearly 90 percent of this land is irrigated with surface water. Bear Lake, at the southern tip of the study area, has a capacity of 1.4 million acre-feet and stores Bear River water for irrigation and power uses between Bear Lake and Great Salt Lake. Likewise, Palisades and American Falls Reservoirs have a combined capacity of about 3 million acre-feet, and they store supplemental water irrigating large tracts in the Snake River valley northwest of the study area. In addition, Blackfoot River Reservoir has a capacity of about 350,000 acre-feet and stores water for irrigating lands east of Blackfoot, and Portneuf Reservoir, with a capacity of about 24,000 acre-feet stores water for irrigating lands in the Portneuf River basin.

Table 1-15.--Annual water use in eight southeast Idaho counties. Figures are in acre-feet

	Bannock	Bear Lake	Bingham	Bonneville	Caribou	Franklin	Oneida	Power
Municipal	13,555	1,135	8,530	31,160	1,285	855	520	920
Industrial	270	0	5,515	31,200	17,845	890	0	3,570
Agricultural[1]	110,000	209,984	717,858	903,000	262,412	200,000 (estimate)	200,000 (estimate)	339,426

[1] Based on the average 14-week irrigation season.

Source: Idaho Department of Health and Welfare, 1975

Additional information is contained in Idaho Water Laws and Regulations, Vols. 1 and 2, Department of Water Resources, State of Idaho.

4. AIR RESOURCES

A primary source of ambient air quality data for this study was the Environmental Services Division of the Idaho Department of Health and Welfare. Ambient monitoring data for sulfur dioxide, particulate and total sulfation were provided. A summary of the data furnished by that agency is listed in Table 1-16. The ambient air quality standards are listed on pp. 1-348/1-349. The following is extracted from a report dated October, 1975, prepared under contract for the Task Force by North American Weather Consultants, Goleta, California. Additional data were obtained from the U. S. Environmental Protection Agency and Beker Industries, Inc.

The direct SO_2 measurements near the J. R. Simplot plant west of Pocatello were made at the Pocatello sewer plant, about five-eighths of a mile north-northeast of the Simplot plant, and at a point about five-eighths of a mile east-northeast of the plant. The data at the sewer plant were collected during January and February 1975. During the 2-month period, the 3-hour standard of 0.5 ppm (parts per million) was not exceeded. The highest 3-hour concentration recorded during that period was 0.41 ppm on January 26, 1975. The highest 24-hour concentration recorded during that period was 0.12 ppm, also on January 26, 1975. The monthly arithmetic mean and standard deviation during January were 0.046 ppm and 0.123 ppm, respectively. The mean and standard deviation during February were 0.010 and 0.029 ppm, respectively. The highest 3-hour average during February was 0.15 ppm. The highest 24-hour average during February was 0.06 ppm.

The results of the SO_2 monitoring done by the J. R. Simplot Company of the maximum 3-hour and 24-hour average concentrations for the days between September 1972, and June 1973, indicate that the ambient air-quality standards were exceeded. During that 10-month period and on a non-overlapping basis, the 24-hour standard, was exceeded 14 times; the 3-hour standard, 7 times. The highest 24-hour average was 0.334 ppm; the highest 3-hour average, 0.889 ppm.

Sulfation plates were also used in the Pocatello area to measure the SO_2 pollution from the Simplot plant. A network of 27 sampling sites within about 5 miles of the plant was employed from 1970 to 1973. The annual averages of monthly total sulfation from the sites in various distance intervals are given in the following table.

Table 1-16.--Ambient-air-quality data provided by Division of Environment, Idaho Department of Health and Welfare

Pollution parameters	Location	Time period	Averaging time
Sulfation	Blackfoot	1970-71	Annual
Sulfation	Idaho Falls	1970-71	Annual
Sulfation	Soda Springs	1970-71	Annual
Sulfation	Pocatello	1970-71	Annual
Sulfation	Vicinity of Simplot plant at Pocatello	1972-73	Monthly
Sulfation	Vicinity of Beker plant at Conda	1972-74	Monthly
SO_2	Pocatello sewer plant	Jan & Feb 1975	Hourly
SO_2	Conda Post Office	Jan & Feb 1975	Hourly
Particulate	Pocatello (3 sites)	1971-74	Monthly
Particulate	Soda Springs (near Monsanto	1971	Monthly
Particulate	Conda (near Beker)	1971-73	Monthly
Particulate	Conda (Post Office)	1972-74	Monthly

--Annual averages of monthly sulfation from 1970 through 1973 at various distance intervals from the Simplot plant. Equivalent average SO_2 concentrations using Huey's (1974) conversion factor are also given

Distance interval from Simplot, in miles	Annual average and sulfation, in g/cm^2/mo and ppm of SO_2			
	1970	1971	1972	1973
0 to 1	166/.017	216/.022	369/.037	357/.036
1 to 2	105/.011	130/.013	106/.011	170/.017
2 to 3	-/-	151/.015	85/.009	136/.014
3 to 5	103/.010	102/.010	76/.008	93/.009

The data show a general increase in average sulfation with time and a decrease with increasing distance from the plant. The estimates of SO_2 concentration suggested that the annual SO_2 standard was exceeded within about 1 mile of the plant during 1972 and 1973. It should be kept in mind, however, that the conversion is only accurate within a factor of 3, but the values within about 1-mile of the plant during 1970 and 1971 were within a factor of 3 of the standard.

Direct measurements of SO_2 concentrations near the Beker plant north of Soda Springs were made in Conda, about three-fourths of a mile south-southeast of the Beker plant, and at a point about 1.2 miles west-northwest of the sulfuric-acid plant. Data from Conda were collected by the State of Idaho during January and February 1975 and by Agricultural Products Corporation, the former owners, from January 1, 1973, to February 28, 1974. Data from the other two locations were collected by the State of Idaho between October 1973 and January 1974.

The data from the Beker coulometric monitor at Conda were reported as hourly averages during January and February 1975. During that time, standards were not exceeded. The data originally provided by the State of Idaho, Department of Environmental and Community Services had indicated values above the standards on January 8, 1975. Subsequently (on October 24, 1976) corrected values showed that no values in excess of 3-hour or 24-hour standards occurred on that day. During the 14-months between January 1973 and February 1974, the 24-hour ambient standard was equaled or exceeded at least 10 times. The highest 24-hour average concentration was 0.32 ppm. On five of those days, the 3-hour standard was also exceeded. The highest 3-hour concentration was 0.85 ppm. All 10 days occurred during the winter months, December, January, and February.

Air quality was monitored by the State of Idaho using 24-hour bubbler samplers at two sites near the Beker plant between October 1973 and January 1974. A 24-hour average was reported for 40 days during that time at the site about three-tenths of a mile east of the plant.

On six of those days, the 24-hour standard was exceeded; the highest 24-hour concentration was 0.70 ppm. At the monitoring site about 1.2 miles west-northwest of the sulfuric-acid plant, the 24-hour ambient SO_2 standard was not equaled or exceeded on any of the days monitored.

Sulfation rates were also used to indirectly measure SO_2 pollution from the Beker fertilizer plant near Conda. A network of 24 sampling sites within about 5 miles of the plant was used during 1972, 1973, and 1974. The annual averages of sulfation for 1973 and 1974 from the sites in various distance intervals are given in the following table. The averages from 1972, divided into periods before and after the plant began operations, are also shown.

--Annual averages of monthly sulfation from 1972 through 1974 at sites in various distance intervals from the Beker plant. Equivalent average SO_2 concentrations using Huey's (1974) conversion factor are also given

Distance interval from Beker, in miles	Average sulfation, ug/cm^2/mo and ppm of SO_2			
	Jan-Aug 1972	Sept-Dec 1972	1973	1974
0 to 1	46/.005	304/.030	368/.037	443/.044
1 to 2	56/.005	171/.017	140/.014	187/.019
2 to 3	66/.007	142/.014	129/.013	144/.014
3 to 5	49/.005	100/.010	112/.011	122/.012

The data show a general increase in sulfation rates with time and a decrease with increasing distance from the Beker plant. The values before September 1972 are from background samples, and the increase in sulfation after September indicates the extent of the SO_2 concentrations produced by the plant. The estimated equivalent SO_2 concentrations derived from the sulfation results suggest that the annual average SO_2 concentrations within about 1 mile of the plantsite equaled or exceeded the ambient standard since the plant reopened. However, as noted earlier, the conversion is not exact and may be only accurate within a factor of 3.

In addition to the sulfation measurements near the two fertilizer plants, background sulfation measurements were made at four cities in the study area. The annual average sulfation rates for 1970 and 1971 are given in the following table. The SO_2 values are all well below the ambient annual standard of 0.03 ppm.

Annual averages of monthly sulfation in 1970 and 1971 at cities in the study area. Equivalent average SO_2 concentrations using Huey's (1974) conversion factor are also given

Location of site	Annual average sulfation, in $ug/cm^2/mo$ and ppm of SO_2	
	1970	1971
Blackfoot	49/.005	88/.009
Idaho Falls	56/.006	115/.012
Inkom	47/.005	55/.006
Soda Springs	72/.007	81/.008

In summary, monitoring of ambient SO_2 in the vicinity of the two fertilizer plants in southeastern Idaho has shown that the 3-hour and 24-hour ambient standards for SO_2 are occasionally violated within a few miles of the plant; monitoring data are sparse farther from the plant. Sulfation-rate data collected near these plants suggest that both may have caused violations in the annual SO_2 standard within a distance of a few miles. The sulfation data also suggest that standards are only being violated within a few miles of the sulfuric-acid plants. The sulfation-rate data are not conclusive, however, because of uncertainties in the relationship between sulfation and ambient SO_2 concentrations.

Measurements of concentrations of total suspended particulates necessarily include area sources (i.e. dirt roads, construction, street repair) Air Quality Profile for Power/Bannock Primary Abatement Area, the Category "dirt roads" was listed in the emission inventory as responsible for nearly 57% of all particulate emissions.

Ambient suspended particulates have been sampled routinely from 1971 through 1974 at three sites in the Pocatello area: at site P2, about five-eighths of a mile north-northeast of the J. R. Simplot plant; at site P5, about 2.4 miles northeast of the plant; and at site P7, about 5.5 miles southwest of the plant. The sampling results are given in the following table.

Annual geometric means of suspended particulate concentrations at sampling sites near Pocatello from 1971 through 1974

Site	Annual geometric mean in ug/m³			
	1971	1972	1973	1974
P2	124	104	100	145
P5	72	71	71	71
P7	50	41	-	68

The annual geometric means of the primary and secondary ambient air-quality standards for suspended particulates are 75 ug/m^3 (micrograms per cubic metre) and 60 ug/m^3, respectively. The sampling at Pocatello shows that both standards were violated at a distance of about five-eighths of a mile, and that only the secondary standard was violated at the other two sites. At the most distant site, the secondary standard was violated only in 1974.

Suspended particulates have been sampled from 1971 through 1974 at three sites in the Conda-Soda Springs area: at site SS 1, about 1 mile north of the Monsanto plant, from 1971 to 1972; at site SS 2, about 1.4 miles west of the Beker plant, from 1971 through 1973; and at site SS 3, in Conda about nine-tenths of a mile south-southeast of the Beker plant, from mid-1972 through mid-1974. The sampling results are given in the following table.

Annual geometric means in ug/m^3 of suspended particulate concentrations at sampling sites near Conda and Soda Springs from 1971 through 1974

Site	1971	1972	1973	1974
SS1	70	--	--	--
SS2	34	36	43	--
SS3	--	106	86	75

The sampling at Conda shows that the primary and secondary standards were equaled or exceeded every year since 1972. Only the secondary standard was exceeded near the Monsanto plant during the 1 year for which data are available, 1971. Neither standard was exceeded about 1.4 miles west of the Beker plant, but both standards were equaled or exceeded in Conda.

In summary, sampling for suspended particulates has shown that both the secondary and primary standards were violated for several years near the FMC-Simplot complex at Pocatello and near the Beker-Simplot complex at Conda. Only the secondary standard was exceeded at distances of about 2.4 miles and more from the FMC-Simplot complex. No samples were taken close to the Monsanto plant, but the secondary standard was exceeded about 1 mile from the plantsite during 1971. At Conda, both standards were equaled or exceeded, but neither standard was violated about 1.4 miles west of the Beker plant.

Fluorine occurs in significant quantities in the phosphate rock that is used as a raw material for phosphate-fertilizer and elemental-phosphorus plants in southeastern Idaho. Fluorine compounds are evolved in various quantities and forms in many of the refining operations and production reactions. Fluorine emissions are controlled to some extent in most of the fluoride-evolving processes, and measures are taken to stabilize and detoxify these substances before they are released into the environment. However, substantial quantities of untreated fluorides are released into the ambient air in the form of particulates, liquids, and gases. The most common forms of these are SiF_4 (silicone tetrafluoride), HF (hydrofluoric acid), and H_2SiF_6 (fluorosilicic acid). These substances elevate ambient air and soil-water fluoride concentrations, resulting in increased fluoride concentrations in the leaf tissues of vegetation. If this vegetation is a food for wildlife, livestock, or humans, it passes to them and may cause fluorosis, a bone disorder.

Fluoride emissions associated with these plants appear to arise mainly from various volatile fluoride compounds remaining in waste ponds. A recent National Research Council document (1970) stated, "Volatile fluorides vaporizing from the ponds are not controlled and may constitute 90 percent or more of the total fluoride emissions to the atmosphere from the (phosphate) industry....The concentrations of hydrofluoric and fluorosilicic acid in the (gypsum) ponds gradually increase when the waters are recirculated into the manufacturing plants for reuse." In order to limit total emissions, total pond acreage, and water use, most production facilities in southeastern Idaho recycle some portion of their pond water.

Other emission sources of fluorine are particulates released during ore production and handling, and fugitive gaseous emissions evolved during refining operations.

The College of Agriculture, University of Idaho, has studied the fluorine levels in the Pocatello and Soda Springs areas from 1955 to 1975. These studies, conducted two to four times each summer, involve cutting the top growth of alfalfa and grass in the vicinity of production facilities. The vegetation is analyzed and the results are expressed in ppm fluorides dry weight. Although this method is useful in determining the fluoride content of local forages (the basis of the Idaho State standards), the data yielded by these techniques do not necessarily indicate average fluoride concentrations in the ambient air. Studies indicate that the various factors governing the relationship between fluoride concentrations in plants and existing ambient air concentrations are not yet well enough understood to allow rational interpretation of field results. Variables such as nature and amount of the emitted fluorides, rate of growth and type of vegetation, amounts and types of precipitation, wind speeds, and insolation, affect forage concentrations.

Fluoride content of forage has been related to the average ambient air concentrations by means of a simple dosage equation:

$$C = K \overline{X} T,$$

where C = fluoride concentration in forage on a dry weight basis (ppm),
K = an accumulation rate of fluorides by forage (ppm/ g/m^3/day),
$\overline{X}$ = average ambient air-fluoride concentration (g/m^3), and
T = number of days the forage was exposed.

On the basis of this equation, H. E. Cramer Company, Inc., in its report to EPA (Cramer and Bower, 1974), assumed the value of K to be between 3 and 4 for the Beker fertilizer plant near Conda. These values have been applied to the University of Idaho forage investigations between 1970 and 1974 in order to obtain average ambient fluoride concentration, although the reservations regarding relationships expressed above apply to these data.

The two main fluorine-emission sources in the Pocatello area are the J. R. Simplot fertilizer plant and the FMC elemental-phosphorus plant. They are close to each other, and no effort was made to separate them as individual sources.

The results of the University of Idaho forage tests during the summers of 1970 to 1974 indicate that monthly ambient averages of 0.33 to 0.44 ug/m^3 exist within an average distance of about 2.8 miles from these plants. These concentrations represent 40 ppm fluorides dry weight in forage, the Idaho State standard for livestock feed. The minimum distance at which these concentrations existed was about 1 mile; the maximum, about 4 miles. Maximum concentrations, generally within about one-half mile of the plants, averaged 0.96 to 1.3 ug/m^3; the greatest measured concentration was 2.2 to 2.9 ug/m^3.

Data released in October 1975 cover the fluorine content of vegetation grown in the vicinity of the phosphate-processing plants located near Pocatello. The range grass in the area south of the FMC and J. R. Simplot plants was sampled on May 2. Alfalfa and other types of vegetation were sampled four times during the summer, from mid-June until late September.

The fluorine levels of the alfalfa samples collected in June and July-August 1975 were similar to those of June and July 1974. The average fluorine content of the June 1975 alfalfa samples was 25 ppm, compared to 27 ppm for the June 1974 alfalfa samples. The July-August 1975 samples averaged 19 ppm while the July 1974 averaged 23 ppm. The alfalfa samples collected in September 1974 showed a very large increase in fluorine content. This was not the case in 1975. The average fluorine content of the alfalfa samples collected in September was 19 ppm, compared to 49 ppm for the September 1974 samples. The results of the 1975 study show that the fluorine levels of the alfalfa samples was lower than in 1974, in fact lower than they have been for several years. A total of 128 alfalfa samples were collected during the summer and only 10 of these showed elevated fluoride levels. The 10 samples were located east and northeast of the FMC and Simplot plants at a distance of 3 miles or less.

In September 1974, the range grass samples collected south of the FMC and Simplot plants showed a very large increase in fluorine content. The average fluorine content of these samples was 120 ppm. Because of the high levels found in September 1974, samples were obtained from the area on May 2 to determine whether a change in the fluorine level occurred during the winter. The data show a small decrease in the fluorine levels for the samples collected on May 2 compared to the levels found in September 1974. The May 1975 samples averaged 105 ppm fluorine, compared to 120 ppm in September 1974. The samples collected in June showed a large decrease in fluorine content. The average for the June samples was 42 ppm, a decrease of 60 percent. There was an increase in the fluorine level of these samples in July (average 66 ppm) and a further increase in September to an average of 92 ppm.

According to the University of Idaho researchers, it is difficult to explain why the fluorine levels in the range grasses remain high while there is a decrease in the alfalfa. The high level found in the range grasses could be due to carry over from previous years contamination. Also, atmospheric conditions and operating parameters of the FMC and Simplot plants caused greater amounts of particulate matter to be deposited on the vegetation. The decrease in the fluorine levels of the June samples compared to those collected in May, could be due to resurgence of growth and increased rainfall washing particulate contaminants from the vegetation.

The phosphate-processing plants in the Soda Springs area are about 4 miles apart, making it difficult to determine the total contribution from each plant. The figures given below represent estimates made by analyzing the impact patterns around the two sites. However, periodic interaction occurs between the two sources to the north of the Monsanto elemental-phosphorus plant and west of the Beker fertilizer plant. Also, elevated fluorine levels were documented near the site while the Beker plant was idle during the summers of 1970 and 1971. It is unknown at this time whether these elevated concentrations resulted from residual fluorine from the settling ponds, construction in the area, or emissions from the Simplot ore-beneficiation plant nearby.

On the basis of the University of Idaho studies of forage concentrations, the following figures approximate the impact near the two plants. Ambient air-fluorine concentrations of 0.33 to 0.44 ug/m^3 existed at ground level an average distance of about 2.2 miles from the Monsanto plant; a maximum distance of about 4 miles. In some cases, this concentration level was not exceeded. Maximum concentrations near the Monsanto plant averaged between 0.57 and 0.77 ug/m^3; the greatest measured concentrations were 1.4 to 1.9 ug/m^3. Concentrations from the Beker plant exceeded 0.33 to 0.44 ug/m^3 an average distance of about 2.4 miles from the plant; a maximum distance of about 4 miles.

Maximum concentrations in the vicinity of the Beker plant averaged 0.69 to 0.92 ug/m^3, generally within about 1 mile of the plant. The maximum measured concentration in forage was 161 ppm, representing 1.34 to 1.79 ug/m^3.

In summary, these studies indicate that while the fluoride content of forage is a nonsystematic measure of atmospheric-fluorine content, concentrations of 0.33 to 0.44 ug/m^3 are probably common within about 1 to 4 miles of the production facilities. Furthermore, average concentrations in excess of about 1.5 ug/m^3 exist near the plantsites at Soda Springs; 2.5 ug/m^3, in the vicinity of the combined plantsites at Pocatello. Plume interaction occurs between the Monsanto and Beker plants north of Soda Springs, and interaction is strongly suggested at the Pocatello sites. There is also evidence that even previously operating and presently idle plants can be a service of significant fluoride emissions. A more systematic and objective measurement program would be necessary to fully document existing fluorine levels in these areas in order to estimate fluoride emissions from future production facilities.

Particulates and gases may become air pollutants in a number of processes in the mining and milling of phosphate ore and the further processing of phosphate products. Particulates are evolved in grinding and drying operations and gases and particulates in calcining and thermal reduction. The decay products of radium, in particular polonium-210, may sorb on particles that are vented to the atmosphere in any of the above operations.

Studies undertaken by the AEC and the Idaho Department of Health in 1970 found gross alpha concentrations in ambient air at Pocatello, Idaho to be about 15 times the background values found elsewhere and polonium-210 concentrations about 100 times background. Polonium-210 concentrations reaching about 41 percent of the AEC allowable limit were reported at the FMC plant. Thorium concentrations 3.25 times the allowable limit were also reported and attributed to triple superphosphate operations at the Simplot plant.

Emission of radioactivity from the plants in the Pocatello area is being studied by the EPA, but results are not yet available. Samples of air taken in November 1973 by the Idaho Department of Health and analyzed by EPA show concentration of polonium-210 ranging from 55 to 110 fCi/m^3 (fCi = femtocurie = 10^{-15} curie) at the Pocatello sewage plant and 68 fCi/m^3 at the Chubbuck School. This is less than 1.6 percent of the established maximum permissible concentration (MPC) in air for the general public of 7000 fCi/m^3 for insoluble polonium-210. The thorium-230 concentration in these samples ranged from 0.63 to 2.2 fCi/m^3 at the sewage plant and 0.55 fCi/m^3 at the Chubbuck School. This represents up to about 3 percent of the MPC for the general public of 80 fCi/m^3 for soluble thorium-230, or up to about 0.7 percent of 300 fCi/m^3 the MPC for insoluble thorium-230. Other alpha emitters, radium-226, and the uranium isotopes 234, 235, and 238 were found to be in much lower concentrations relative to their respective MPC's in air, as shown in table 1-17.

In September, 1975, the EPA sampled stack emissions at the FMC plant in Pocatello. Results of the analyses of these samples are not available as of January, 1976.

While the levels found to date are substantially below recommended limits, further studies are required to evaluate the contribution of phosphate mining and milling to the natural ambient levels of radioactivity in air.

Six snow samples were collected by the U.S. Geological Survey in March 1975 in the vicinities of Pocatello and Conda-Soda Springs, to try to determine if airborne particulates from processing operations could be detected in snowmelt.

Chemical analyses consisted of quantitative determinations of major and several trace elements in the filtrate and semi-quantitative estimations of trace elements in the particulate material. The sampling, done near the end of the snow season, was limited by availability of snow accumulations.

Generally, no conclusions can be made on the basis of the data. Concentrations were not significantly different in samples collected near processing areas, compared to those at distances from the plants. One of the samples collected near Monsanto's elemental-phosphorus plant near Soda Springs showed a trace of thallium (0.1 g/l) in the snowmelt filtrate and 15 ppm thallium in the particulate material collected on the filter. In both cases, the results were near detection limits for the analytical techniques. None of the concentrations represents harmful levels.

No quantitative data are available to assess the impact of the operating phosphate mines. Qualitatively, uncontrolled particulate emissions from phosphate mining are believed to be about 0.5 pounds per ton. Maximum emissions would occur during the hot, dry, summer months during moderate wind conditions. The location of a mine, with respect to terrain features, is a factor in the amount of particulates that are emitted. For example, emissions from mines situated in a valley should be less than those from a mine located on a mountaintop and exposed to strong winds. On the other hand, the particulates emitted from a mountaintop mine will be quickly dispersed by the wind whereas dispersal of particulates in a sheltered valley would not be as great.

Table 1-17.--Radioactive components of air filtrates in Pocatello, Idaho, area

Elements in Femtocuries per cubic metre of air		Th-230	Th-232	Po-210	Ra-226	U-234	U-235	U-238
Maximum permissible concentrations for general public								
Soluble		80	70	20,000	1000	20,000	20,000	3000
Insoluble		300	400	7,000	6 million	4,000	4,000	5000
Location	Date							
Chubbuck School	8/5/73	0.55	0.23	68	23	0.57	0.032	0.50
Sewage Plant	8/5/73	.9	.12	95	14	.72	.040	.75
	8/8/73	1.8	.22	110	21	1.8	.082	1.8
	8/14/73	.63	.095	50	9	.53	.020	.53
	8/17/73	.83	.09	78	11	.70	.030	.62
	8/23/73	2.2	.23	50	24	2.0	.073	2.2
	8/26/73	.93	.15	55	12	.73	.037	.8
	8/29/73	.85	.16	53	13	.75	.040	.8

Source of data: Environmental Protection Agency

5. VEGETATION

The vegetation in the study area is transitional between the Great Basin vegetation to the south and the Rocky Mountain vegetation to the north.

The vegetal cover types are a result of aspect, elevation, moisture, temperature, and soils. This results in a complex mosaic over much of the area, integrating combinations of most of the vegetal cover types throughout the study area. The total production of vegetation is generally greater at upper elevations than at the lower elevations. Generally this break is near 7,000 feet in elevation.

The area has been broken into six vegetal cover types:

Type	Percent of Area
Conifer-aspen	30
Mountain brush	4
Sagebrush-grass	35
Riparian	2
Marshlands	6
Agricultural	18

About 5 percent of the area is in water, roads, and urban development, etc. Species occurring in these cover types are listed in table 1-18.

The conifer-aspen cover type has either coniferous trees or quaking aspen as the dominant vegetation. Aspen is believed to be seral, with conifers being climax on all areas within this cover type. Conifers present are Douglas fir, limber and lodgepole pines, subalpine fir, and Englemann spruce. Dominant understory plants include pinegrass, wild rye, bluegrass, snowberry, and grouse whortleberry. The conifer-aspen cover type is not present in large, contiguous blocks but is interspersed with inclusions of various other cover types. The conifer-aspen type is most often found on the north- and east-facing slopes. At higher elevations it occurs independently of aspect. This cover type is found on moderately deep to very deep, loamy soils. In very few instances is it found on poorly drained sites. Neither geology nor degree of stoniness appears to have much influence on the occurrence of this cover type.

This cover type contains the marketable timber, but potential yield falls in the unproductive to medium-productive categories (from less than 20 to up to 120 cubic feet per acre per year). Since the mid 1960's, the total cut on the National Forest within the study area has averaged less than 8 million board feet per year, including posts and poles. From July 1973 through June 1974, some 10.5 million board feet of timber was cut on the Caribou Forest, valued at about $300,000. A little more than 80 percent of this was within the study area. The board feet of timber on National Resource Lands (BLM) within the study

Table 1-18.-- Common vegetation species by cover type.

Common name	Scientific name
CONIFER-ASPEN COVER TYPE	
Trees	
Douglas fir	*Pseudotsuga menziesii*
Elgelmann spruce	*Picea engelmanii*
Limber pine	*Pinus flexilis*
Lodgepole pine	*Pinus contorta*
Quaking aspen	*Populus tremuloides*
Subalpine fir	*Abies lasiocarpa*
Shrubs	
Big whortleberry	*Vaccinium membranaceum*
Chokecherry	*Prunus virginiana*
Currant	*Ribes spp.*
Greene's mountainash	*Sorbus scopulina*
Grouse whortleberry	*Vaccinium scopulinum*
Mallow minebark	*Physocarpus malyaceous*
Mountain big sagebrush	*Artemisia tridentata*
Mountain maple	*Acer glabram*
Myrtle pachistima	*Pachistima myrsinites*
Oregon grape	*Berberis repens*
Redosier dogwood	*Cornus stolonifera*
Scouler willow	*Salix scouleriana*
Snowberry	*Symphoricarpos oreophilous*
Snowbrush	*Ceanothus velutinous*
Forbs	
Cutleaf balsam root	*Balsamorhiza macrophylla*
Engelmann aster	*Aster engelmanii*
Eriogonum	*Eriogonum spp.*
Fendler meadowrue	*Thalictrum fedleri*
Fernleaf pedicularis	*Pedicularis bracteosa*
Heartleaf arnica	*Arnica cordifolia*
Horsetail	*Equisetum spp.*
Lupine	*Lupinus spp.*
One-flower helianthella	*Helianthella uniflora*
Sticky geranium	*Geranium viscosissimun*
Strawberry	*Fragaria spp.*
Sweet anise	*Osmorhiza occidentalis*
Western thimbleberry	*Rubus parviflora*
Western valerian	*Valeriana occidentalis*

Table 1-18.--Common vegetation species by cover type--Continued

Common name	Scientific name
CONIFER-ASPEN COVER TYPE--Continued	
Grasses	
Blue wildrye	*Elymus glauca*
Bluejoint reedgrass	*Calamagrostis canadensis*
Mountain brome	*Bromus carinatus*
Oniongrass	*Melica bulbosa*
Pinegrass	*Calamagrostis rubescens*
Prairie junegrass	*Koeleria cristata*
Sandberg bluegrass	*Poa secunda*
Sedge	*Carex spp.*
MOUNTAIN-BRUSH COVER TYPE	
Trees	
Douglas fir	*Pseudotsuga menziesii*
Rocky Mountain juniper	*Juniperus scopulorum*
Utah juniper	*Juniperus utahensis*
Shrubs	
Antelope bitterbrush	*Purshia tridentata*
Curlleaf mountain mahogany	*Cercocarpus ledifolius*
Mountain big sagebrush	*Artemisia tridentata*
Saskatoon serviceberry	*Amalanchier alnifolia*
Snowberry	*Symphoricarpos oreophilous*
Forbs	
Arrowleaf balsamroot	*Balsamorhiza sagitatta*
Aster	*Aster spp.*
Eriogonum	*Eriogonum spp.*
Tapertip hawksbeard	*Crepis acuminata*
Thistle	*Cirsium spp.*
Grasses	
Bluebunch wheatgrass	*Agrophyron spicatum*
Great Basin wildrye	*Elymus cinereus*
Indian ricegrass	*Oryzopsis hymenoides*
Prairie junegrass	*Koeleria cristata*

Table 1-18.--Common vegetation species by cover type--Continued

Common name	Scientific name
SAGEBRUSH-GRASS COVER TYPE	
Shrubs	
Antelope bitterbrush	*Purshia tridentata*
Big sagebrush	*Artemisia tridentata* var. *tridentata*
Black sagebrush	*Artemisia arbuscula* var. *nova*
Chokecherry	*Prunus virginiana*
Horsebrush	*Tetradymia spp.*
Mountain big sagebrush	*Artemisia tridentata* var. *vaseyana*
Oregon grape	*Berberis repens*
Rabbitbrush	*Chrysothamnus viscidiflorus*
Saskatoon serviceberry	*Amalanchier alnifolia*
Shrubby cinquefoil	*Potentilla fruticosa*
Silver sagebrush	*Artemisia cana*
Snowberry	*Symphoricarpos oreophilus*
Forbs	
Arrowleaf balsamroot	*Balsamorhiza sagitatta*
Aster	*Aster spp.*
Eriogonum	*Eriogonum spp.*
Fleabone daisy	*Erigeron spp.*
Gland cinquefoil	*Potentilla fruticosa*
Horsemint	*Agastache urtricifolia*
One-flower helianthella	*Helianthella uniflora*
Penstemon	*Penstemon spp.*
Scarlet paintbrush	*Castilleja chromosa*
Showy goldeneye	*Viguiera multiflora*
Sticky geranium	*Geranium viscosissimum*
Tapertip hawksbeard	*Crepis acuminata*
Tarragon sagebrush	*Artemisia dracunculoides*
Western yarrow	*Achillea millefolium*
Grasses	
Big mountain brome	*Bromus carinatus*
Bluebunch wheatgrass	*Agropyron spicatum*
Cheatgrass	*Bromus tectorum*
Great Basin wildrye	*Elymus cinereus*
Idaho fescue	*Festuca idahoensis*
Medusa head	*Elymus caput-medusae*
Oniongrass	*Melica bulbosa*
Prairie junegrass	*Koeleria cristata*
Sandberg bluegrass	*Poa secunda*
Slender wheatgrass	*Agropyron trachycaulum*

Table 1-18.--Common vegetation species by cover type--Continued

Common name	Scientific name
RIPARIAN COVER TYPE	
Shrubs	
Shrubby cinquefoil	*Potentilla fruticosa*
Silver sagebrush	*Artemisia cana*
Wax currant	*Ribes cereum*
Willows	*Salix spp.*
Woods rose	*Rosa woodsii*
Forbs	
Aster	*Aster spp.*
Butterweed groundsel	*Senecio serra*
Engelmann aster	*Aster engelmannii*
Fendler meadowrue	*Thalictrun fendleri*
Gland cinquefoil	*Potentilla glandulosa*
Nettle	*Urtica diocia*
Sego lily	*Calochortus nuttali*
Western yarrow	*Achillea millefolium*
Yanpa	*Carun gairdveri*
Grasses	
Kentucky bluegrass	*Poa pratensis*
Mat muhly	*Muhlenbergia richardsonii*
Meadow barley	*Hordeum barchyanthum*
Sedge	*Carex spp.*
Spike rush	*Eleocharis spp.*
Tufted hairgrass	*Deschampsia caespitosa*
MARSHLAND COVER TYPE	
Shrubs	
Redosier dogwood	*Cornus stolonifera*
Willows	*Salix spp.*
Forbs	
Arrowhead	*Sagittaria spp.*
Coontail	*Ceratophyllum spp.*
Duckweed	*Lemna spp.*
Mosses	
Pondweed	*Potamogeton spp.*
Watercress	*Rorippa nasturtium-aquaticum*
Grasses	
Cattail	*Typha spp.*
Rushes	*Juncus spp.*
Sedges	*Carex spp.*
Spikerush	*Eleocharis spp.*

area was calculated in the early 1960's to be 76 million board feet. There has only been one timber sale of any size on National Resource Lands in the past 10 years. This sale was in 1973 for 38,000 board feet. Future projections on the Caribou Forest call for a cut of 13 million board feet per year. Rotation length is probably 120 to 150 years for saw timber.

Insect and disease problems in the study area are small. Spruce budworm has been observed in the Douglas fir, but only in small groups of mature stands. There is some mountain pine beetle activity in lodgepole pine stands but it is not prevalent.

The conifer-aspen vegetative type has a high capacity for intercepting precipitation and retarding surface flow. Rainfall is intercepted by the vegetative cover, through which it trickles into the soil. Surface runoff may occur when the soils become saturated or composed of dense clay material. In most such cases, the dense vegetative cover protects the ground from erosion. However, water concentrated by construction activities may develop enough force to destroy this protective cover.

The mountain brush cover type is dominated by shrub species such as bitterbrush, serviceberry, snowberry, chokecherry, mountain maple, mountain mahogany and juniper. Sagebrush is almost always present but is at best codominant. Owing to the varied requirements of the different species, this cover type is found on a wide range of sites. This cover type at lower elevations occurs on all aspects but at higher elevations typically occurs on south- and west-facing slopes and ridge tops.

In some places juniper and mountain mahogany are found interspersed. In most instances; however, almost pure mahogany or pure juniper stands occur. The understory consists of many perennial grasses, forbs, and shrubs. This cover type is generally found at higher elevations than is the sage-grass cover type. It occupies more xeric sites than does the conifer-aspen type. The more common vegetation include bitterbrush, big sagebrush, arrowleaf balsamroot, bluebunch wheatgrass, and Indian ricegrass. At the lower elevations (generally below 6,000 feet), the perennial understory has sometimes been replaced by annual plant species.

The mountain brush cover type has a wide range of soil tolerances but is generally found on moderately to very deep, medium textured, well-drained soils. The juniper and mahogany occur on shallow, stony, limestone-derived soils at elevations from 6,000-7,500 feet. The mountain-brush type provides some of the big game winter ranges in the study area.

The mountain-brush vegetative type has a moderate to high capacity for intercepting and retarding surface flow. It provides excellent ground protection but lacks the large volumes of organic material in the conifer-aspen type. Surface runoff is related to the infiltration capacity and permeability of the underlying rock and soil. The protection provided by this vegetative type is reduced as grazing and other uses are increased.

The sagebrush-grass cover type occurs at lower elevation than the mountain brush cover type and usually on less productive soils. In the study area, it occurs largely on the Bear Lake Plateau and north of the Chesterfield Range. This cover type occurs at elevations of 5,000 to 7,000 feet. Generally, bitterbrush, serviceberry, and snowberry are associated but are definitely less then codominant. Idaho fescue and bluebunch wheatgrass found in the mountain brush type is replaced more by squirrel tail, sandberg bluegrass, and some Indian ricegrass. On some of the more rocky windswept ridges, black sage is dominant. Juniper commonly occurs in this cover type.

The sagebrush-grass cover type, when undisturbed, has a moderate capacity for intercepting rainfall. Grazing, recreation, or other activities often greatly reduce the vegetative cover and compact the soil, reducing infiltration and increasing surface runoff and erosion. Surface runoff often occurs during periods of snowmelt if the mass of organic matter is not great enough to retard or intercept flow. During periods of snowmelt, the soils may or may not become saturated. Their infiltration capacity and permeability are greatly affected by the amount of organic material and the degree of prior saturation.

Much of the agricultural lands was once covered by this sagebrush-grass type. This type is probably the slowest to recover from abuse.

The riparian cover type is typified by sedges, rushes, and similar grasses. This type generally has a shrubby overstory of willows except where removed by treatments such as chemical spraying. It is found along the edges of streams and ponds and in poorly drained canyon and valley bottoms. It is dependent on a water table at or very near the ground surface during most of the year. During spring runoff, much of this type is inundated. Most of it has been reduced and/or altered from its natural state by mechanical treatment or by agricultural practices in the valley bottoms. This alteration is particularly evident in Browns Canyon-Upper Valley, Slug Creek, and along the Bear River from Soda Springs southeast into Wyoming.

The riparian vegetative type usually has a high capacity for intercepting rainfall but has a low capacity for intercepting snow. Runoff is often high because of high water tables and low infiltration capacities of soil. Erosion is usually low because of the high density of vegetation. This type usually has a high capacity for filtering out sediment of overland flows from other areas, and it is easily disturbed by overuse. This vegetative type is naturally important for sediment control and streambank protection.

The marshland cover type occurs on areas inundated with water during all or most of the growing season; it includes swamps, marshes, shallow potholes, ox-bow lakes, and the peripheries of large water bodies. Excellent examples of this type are Grays Lake and Dingle Swamp. The marshland cover type is divided into two types, emergent and submergent. Typical emergent plants include cattails, rushes, and sedges. Typical submergent plants include coontail, pondweed, mosses and waterlily. Plants are rooted in soft sediments. Root systems are not very strong. Any grazing use of this zone occurs where the water is shallow and the bottom is firm during low water seasons. Some of this cover type has been modified by rechannelization and drainage systems.

The marshland cover types have a low capacity for intercepting any type of precipitation. Where they exist, water movement is slowed and particulate matter settles out. The dissolved constituents of water flowing into the marsh may undergo complex chemical changes before being discharged.

The agricultural cover types in the study area vary, depending on the type of crop grown. The greatest percentage of the agricultural lands were once the riparian, marshland, and sagebrush-grass types. In Caribou and Bear Lake Counties, the most common crops are small grains (wheat, barley, and oats), some grass, and alfalfa hay and pasture. Additional crops grown in Bingham and Bonneville Counties include potatoes, sugar beets, corn, and a significant production of alfalfa hay. Typically, the agricultural lands are in the broad valley bottoms and are considered the most productive lands of all the cover types. However, vast acreages in dry land farms produce small grain crops. Dry land farming represents the greatest percentage of the agricultural lands, but irrigation by sprinkler system is increasing in popularity.

The agricultural cover type near the headwaters of tributaries is practically all hay and pasture grasses. This type provides only a low interception capacity and a low impedance to surface runoff.

There are approximately 10 fires per year on the Caribou Forest, with 80 percent of the fires less than ½ acre in size and only 1 out of 10 being over 10 acres in size. About 2 out of 3 fires are caused by lightning. The larger fires are caused by man. Although these occurrences are not concentrated in any particular area, more fires seem to occur in the south half of the Forest. Seldom are the fuels above the 7,000-foot elevation dry enough to carry fire for extended periods or over large acreages. Mid-July through August has the highest fire danger. At other times, when the grasses and fuels do become dry enough to burn, the cool evenings tend to retard fire spread.

The National Resource Lands (BLM) are protected under a contract basis, and no detailed information is available on the number of fires, acreages, and size within the study area. It has been estimated though, that 90 percent of the fires are less then 10 acres in size, and in the last 10 years only one fire burned over 100 acres. This fire was in the southeast end of the study area in the Bear Lake Plateau.

In the past, conifers in Georgetown Canyon were killed by emissions from the now-inactive elemental-phosphorus plant in the canyon.

Vegetation in the vicinity of the processing plants in both the Pocatello and Soda Springs-Conda areas show elevated concentrations of trace metals within the plant materials. A study by the U.S. Geological Survey for the Task Force showed the following. Samples were obtained in May, 1975.

Concentrations of nine trace elements (cadmium, chromium, fluorine, lithium, nickel, selenium, uranium, vanadium, and zinc) increase within the tissues of either sagebrush or grass as the processing plants at Pocatello or Soda Springs are approached (Tables 1-18a). The data for selected elements are shown graphically in figures 1-18 through 1-21. Concentrations of these elements within a mile of the processing plants are typically about nine times their concentrations 30 miles from the plants. The concentrations of fluorine and vanadium in the sagebrush near the plants are more than 50 times their concentrations 30 miles. The observed concentrations are judged to be unusually high for all nine elements in both sagebrush and grass within 0.5 to 1 mile of the plants; for cadmium, chromium, lithium, nickel, uranium, and vanadium in sagebrush within 6 miles of the Pocatello plants; for cadmium, chromium, uranium, vanadium, and zinc in grass within 6 miles of the Pocatello plants; and for cadmium in grass within 6 miles of the Soda Springs plants. No significant relationships were found for aluminum, barium, boron, cobalt, copper, iron, lead, magnesium, manganese, molyobdenum, phosphorus, silicon, sodium, strontium, titanium, and zircanium.

At elevated levels cadmium, chromium, lithium, nickel, and zinc may interfere with vegetative health and fluorine and zinc may be toxic to animals if ingested. Chromium, fluorine, nickel, selenium, vanadium, and zinc are known or suspected to occur in forms that are biologically usable by animals or humans. Idaho air-quality standards specify that the concentration of fluorine in the air must not result in a total fluoride concnentration in feed and forage of more than 80 ppm (dry weight) for up to a month, 60 ppm per month for two consecutive months, or 40 ppm annual arithmetic mean. Fluorine concentrations measured in grass within 2 miles of the processing plants at both Pocatello and Soda Springs ranged from 50 to 220 ppm; in sage, they ranged from 170 to 1,100 ppm.

Details of another separate study by the University of Idaho on fluorine concentrations are discussed in the section on Air Quality in this chapter.

THREATENED AND ENDANGERED SPECIES

The Endangered Species Act of 1973 authorized the Secretary of the Interior to designate threatened and endangered plants as well as animals. The Act also directed the Smithsonian Institution, in conjunction with other agencies, to prepare a list of plants considered to be endangered or threatened.

On December 15, 1974, the Smithsonian Institution submitted to Congress a list of 2,099 plants in the United States and about 1,000 endangered plants in Hawaii. On July 1, 1975, the Fish and Wildlife

Table 1-18a. --ELEMENTAL CONTENT OF THREE PLANT MATERIALS AS A FUNCTION OF DISTANCE FROM PHOSPHATE PROCESSING PLANTS.

ELEMENT	TRAVERSE	PLANT MATERIAL 1/	CORRELATION COEFFICIENT 2/	EXPECTED CONCENTRATION (PPM) AT INDICATED DISTANCE (KM) FROM PROCESSING PLANT 4/			
				1	5	10	50
Cadmium	Pocatello NE	S	-.98 **	200	50	27	7
	SW	S	-.95 **	53	16	9	3
	Soda Sp. NW	S	-.71 **	260	91	58	21
	SE	S	-.73 **	60	30	22	11
	Pocatello NE	C	-.67 *	16	7	5	2
	SW	C	-.50				
	Soda Sp. NW	G	-.77 **	221	49	26	6
	SE	G	-.85 **	35	13	9	3
Chromium	Pocatello NE	S	-.92 **	964	269	156	43
	SW	S	-.87 **	120	63	48	25
	Soda Sp. NW	S	-.79 **	607	186	112	34
	SE	S	-.90 **	238	84	54	19
	Pocatello NE	C	-.63 *	82	40	30	14
	SW	C	-.53				
	Soda Sp. NW	G	-.67 *	100	49	36	18
	SE	G	-.44				
Fluorine	Pocatello NE	S	-.91 **	1250	199	90	14
	SW	S	-.77 **	58	37	31	20
	Soda Sp. NW	S	-.92 **	403	54	23	3
	SE	S	-.74 **	44	23	18	9
	Pocatello NE	C	-.78 *	129	52	35	14
	SW	C	-.40				
	Soda Sp. NW	G	-.77 **	73	37	27	14
	SE	G	-.82 **	42	24	19	11
Lithium	Pocatello NE	S	-.54				
	SW	S	-.17				

Table 1-18a. --ELEMENTAL CONTENT OF THREE PLANT MATERIALS AS A FUNCTION OF DISTANCE FROM PHOSPHATE PROCESSING PLANTS.--CONTINUED

ELEMENT	TRAVERSE	PLANT MATERIAL 1/	CORRELATION COEFFICIENT 2/	EXPECTED CONCENTRATION (PPM) AT INDICATED DISTANCE (KM) FROM PROCESSING PLANT 4/			
				1	5	10	50
	Soda Sp. NW	S	-.89 **	40	10	6	2
	SE	S	.38				
	Pocatello NE	C	.31				
	SW	C	.00				
	Soda Sp. NW	G	-.23				
	SE	G	-.20				
Nickel	Pocatello NE	S	-.90 **	82	38	27	13
	SW	S	-.13				
	Soda Sp. NW	S	-.78 **	37	26	22	16
	SE	S	-.40				
	Pocatello NE	C	-.20				
	SW	C	-.36				
	Soda Sp. NW	G	-.50				
	SE	G	.17				
Selenium	Pocatello NE	S	-.94 **	0.63	0.27	0.18	0.08
	SW	S	-.53				
	Soda Sp. NW	S	-.89 **	2.02	0.38	0.18	0.13
	SE	S	-.69 **	0.22	0.14	0.11	0.07
	Pocatello NE	C	-.84 **	0.34	0.17	0.13	0.06
	SW	C	-.64 *	0.11	0.07	0.06	0.04
	Soda Sp. NW	G	-.92 **	2.19	0.50	0.27	0.06
	SE	G	-.92 **	0.50	0.23	0.17	0.08
Uranium	Pocatello NE	S	-.97 **	28	8	7	1
	SW	S	-.86 **	4	2	2	1

Table 1-18a. --ELEMENTAL CONTENT OF THREE PLANT MATERIALS AS A FUNCTION OF DISTANCE FROM PHOSPHATE PROCESSING PLANTS.--CONTINUED

ELEMENT	TRAVERSE		PLANT MATERIAL 1/	CORRELATION COEFFICIENT 2/	EXPECTED CONCENTRATION (PPM) AT INDICATED DISTANCE (KM) FROM PROCESSING PLANT 4/			
					1	5	10	50
	Soda Sp.	NW	S	-.86 **	12	5	4	2
		SE	S	-.82 **	5	3	2	1
	Pocatello	NE	C	-.58				
		SW	C	-.33				
	Soda Sp.	NW	G	-.83 **	7	4	3	2
		SE	G	-.76 **	4	2	2	1
Vanadium	Pocatello	NE	S	-.92 **	1093	304	176	49
		SW	S	-.62 *	119	83	71	49
	Soda Sp.	NW	S	-.92 **	1748	290	134	22
		SE	S	-.79 **	357	117	84	38
	Pocatello	NE	C	-.54				
		SW	C	-.64 *	44	32	28	20
	Soda Sp.	NW	G	-.84 **	377	117	71	22
		SE	G	-.80 **	155	55	36	13
Zinc	Pocatello	NE	S	-.95 **	1290	783	632	383
		SW	S	-.74 **	647	477	718	309
	Soda Sp.	NW	S	-.75 **	3440	1399	951	386
		SE	S	-.60 *	895	707	639	505
	Pocatello	NE	C	-.52				
		SW	C	-.39				
	Soda Sp.	NW	G	-.75 **	1434	703	518	254
		SE	G	-.76 **	504	354	304	213

1/ S, sagebrush (*Artemisia tridentata*); C, cheatgrass (*Bromus tectorum*); G, unknown grass composite.
2/ *, significant at the 95 percent confidence level; **, significant at the 99 percent confidence level.
3/ Determined on dry weight.
4/ Shown for significant correlations only.

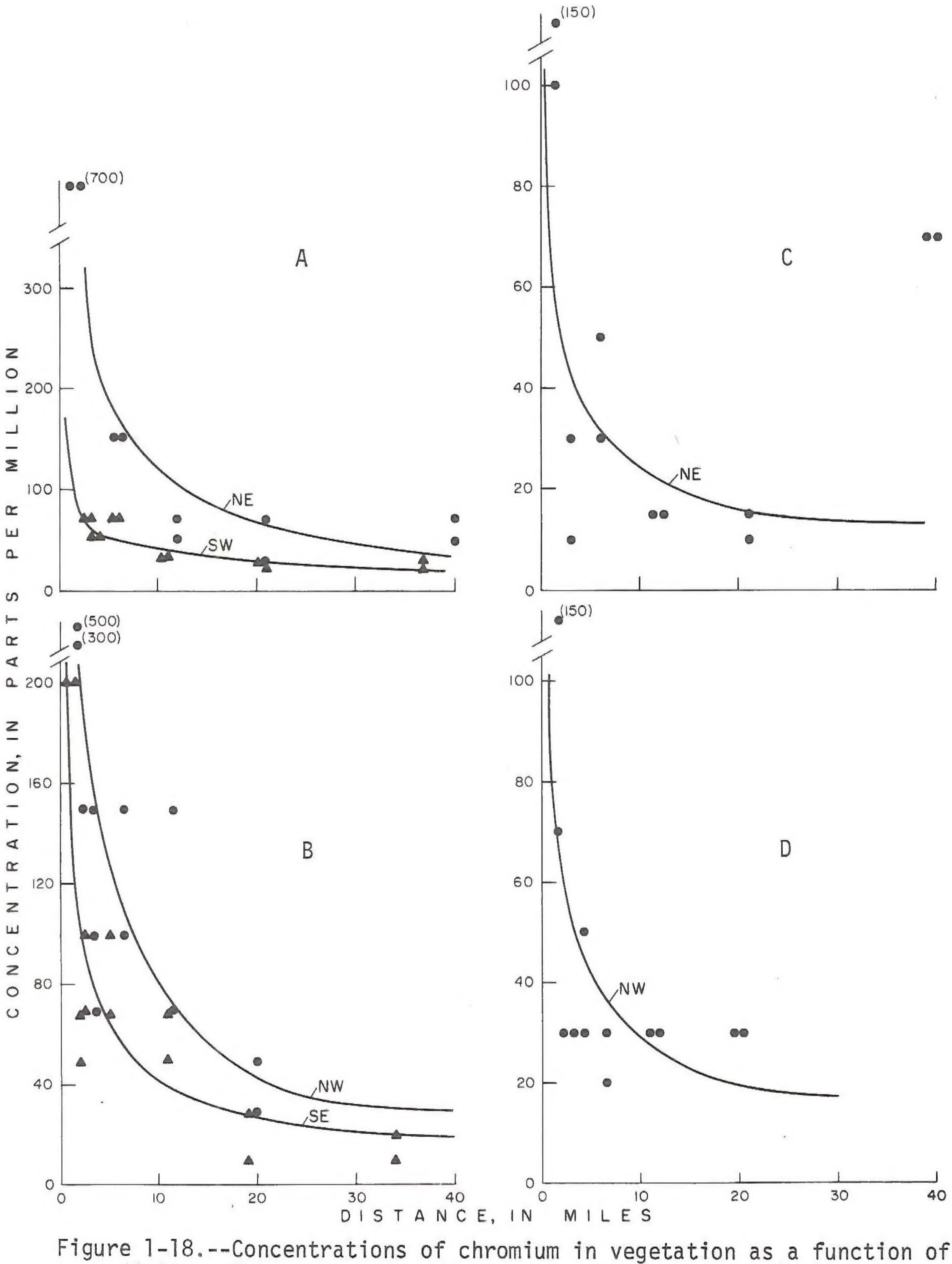

Figure 1-18.--Concentrations of chromium in vegetation as a function of distance from processing plants. Circle, northeast (NE) transect at Pocatello or northwest (NW) transect at Soda Springs; triangle, southwest (SW) transect at Pocatello or southeast (SE) transect at Soda Springs. A, sagebrush near Pocatello; B, sagebrush near Soda Springs; C, cheatgrass near Pocatello; D, composited grasses near Soda Springs.

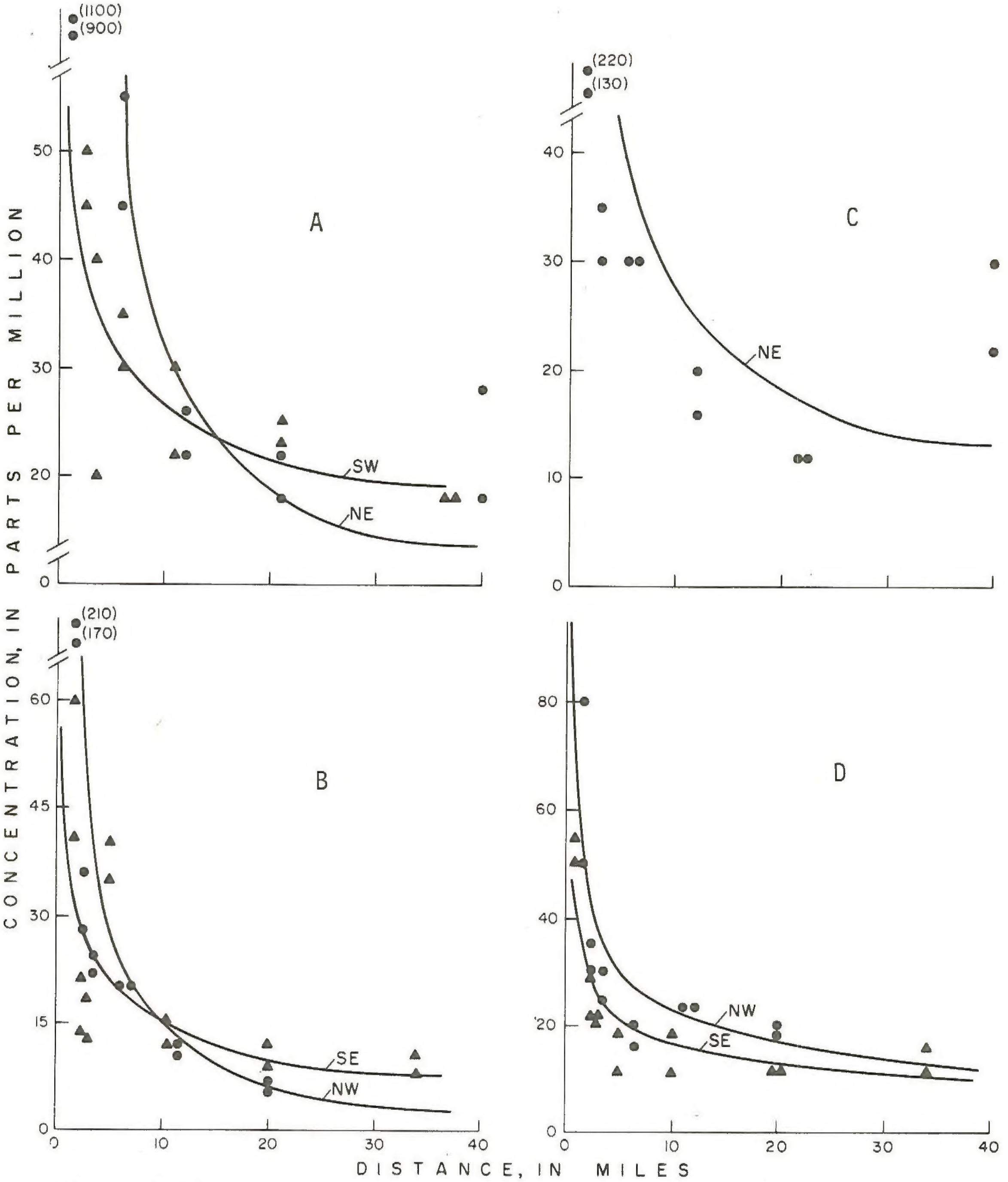

Figure 1-19.--Concentrations of fluorine in vegetation as a function of distance from processing plants. Circle, northeast (NE) transect at Pocatello or northwest (NW) transect at Soda Springs; triangle, (SW) transect at Pocatello or southeast (SE) transect at Soda Springs. A, sagebrush near Pocatello; B, sagebrush near Soda Springs; C, cheatgrass near Pocatello; D, composited grasses near Soda Springs.

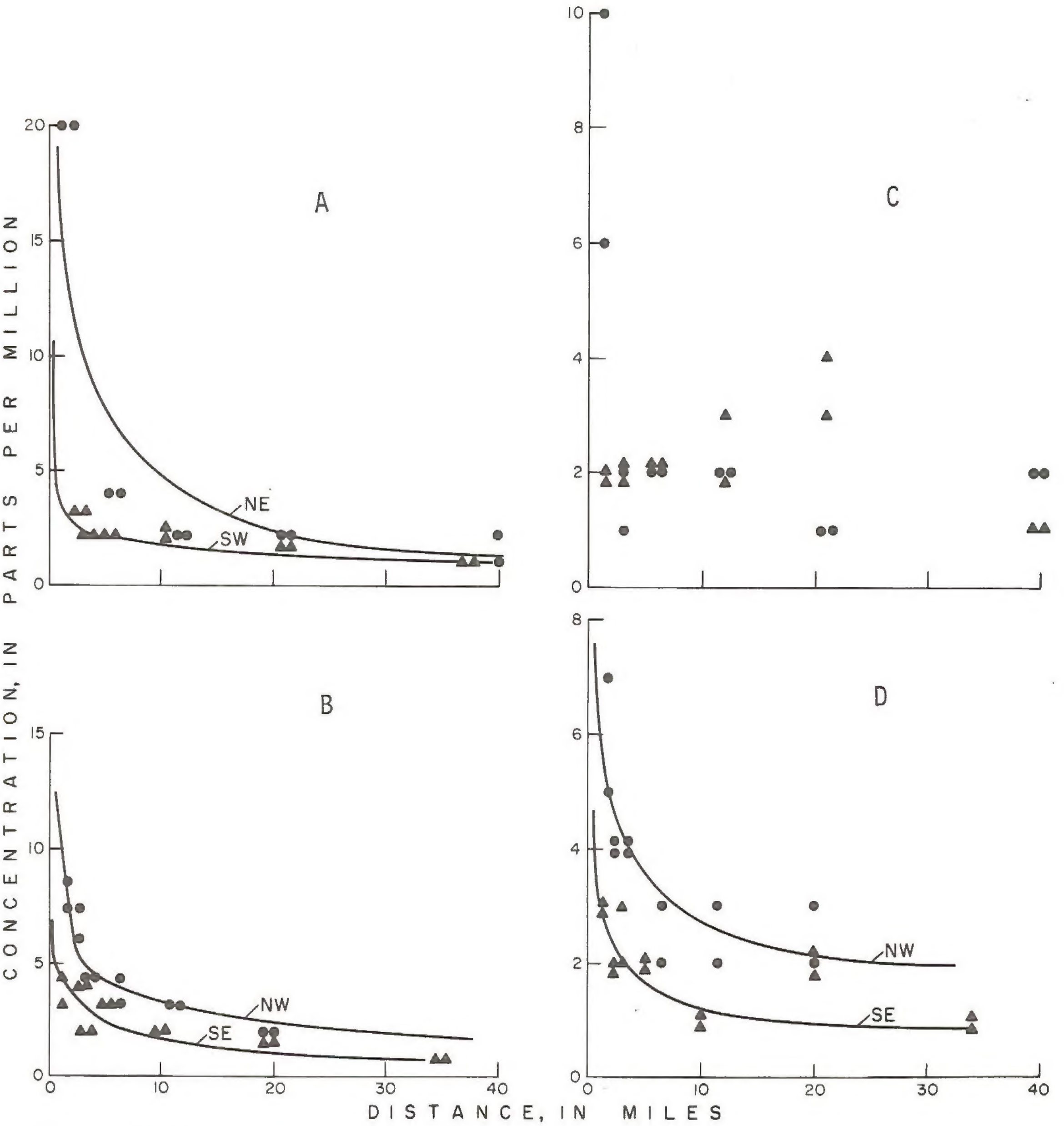

Figure 1-20.--Concentrations of uranium in vegetation as a function of distance from processing plants. Circle, northeast (NE) transect at Pocatello or northwest (NW) transect at Soda Springs; triangle, southwest (SW) transect at Pocatello or southeast (SE) transect at Soda Springs. A, sagebrush near Pocatello; B, sagebrush near Soda Springs; C, cheatgrass near Pocatello (no significant correlation); D, composited grasses near Soda Springs.

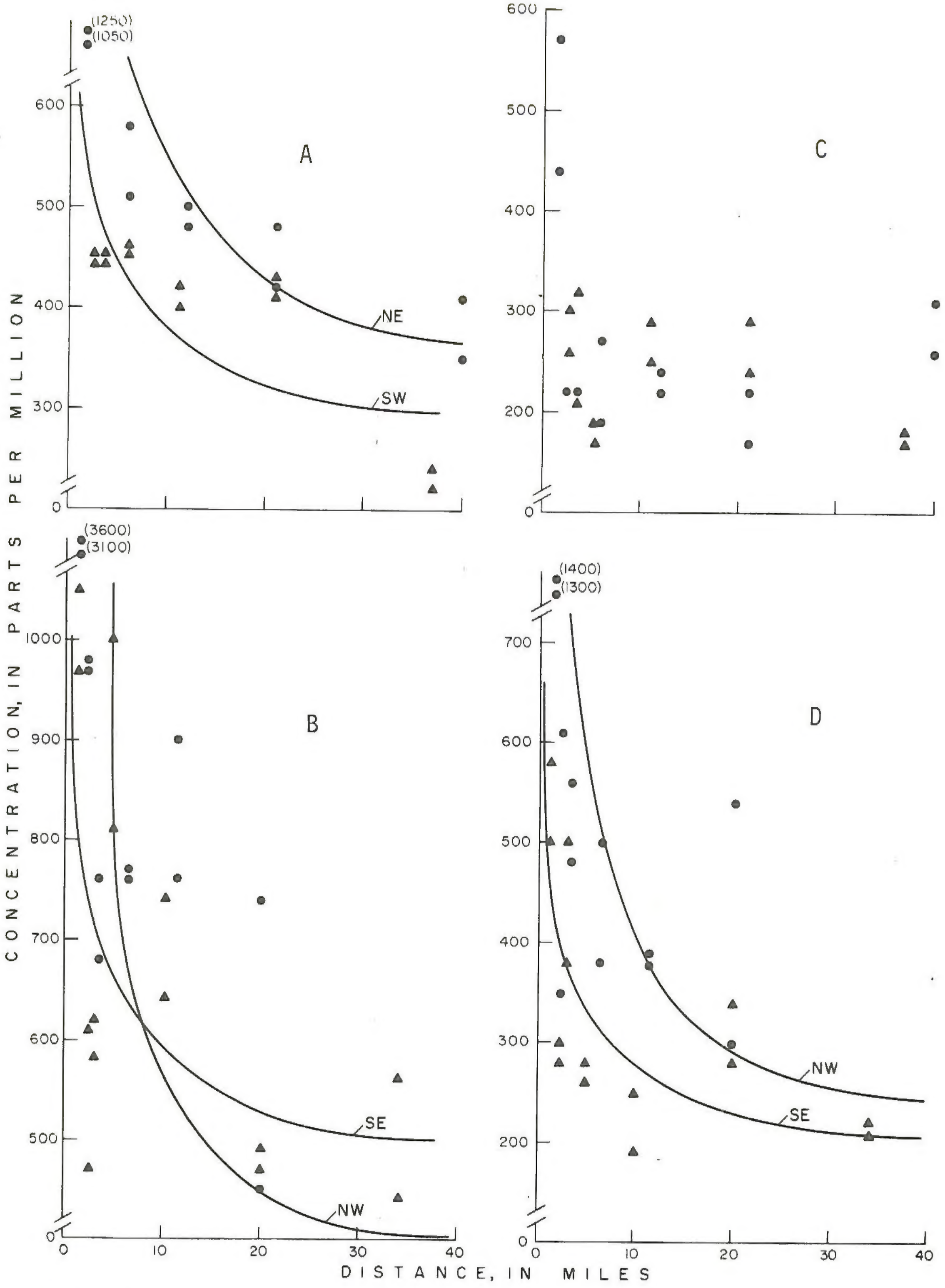

Figure 1-21.--Concentrations of zinc in vegetation as a function of distance from processing plants. Circle, northeast (NE) transect at Pocatello or northwest (NW) transect at Soda Springs; triangle, southwest (SW) transect at Pocatello or southeast (SE) transect at Soda Springs. A, sagebrush near Pocatello; B, sagebrush near Soda Springs; C, cheatgrass near Pocatello (no significant correlation); D, composited grasses near Soda Springs.

Service published this list, together with 57 additional plants, in the Federal Register, Vol 40, No. 127, as the "notice of consideration" provided for in the Act.

No plant species have as yet been declared threatened or endangered under the terms of the 1973 Act. No plant species on the Smithsonian list are known to occur in the phosphate study area.

6. WILDLIFE

A spur of the northern coniferous forest of North America extends southward down the crest of the Rocky Mountains through the study area. Here, the vegetative influence from the south which varies from that of the north due largely to differences in temperature and moisture is intermingled with that of the north. The resulting highly varied, plant community pattern is further influenced by factors including variations in elevation, soils, and direction of slope. In a broad sense, the study area is in a vegetative transition zone and contains a large variety of plant and animal communities. Because of this, the plant associations present have been grouped into six categories. These are (1) the coniferous-aspen, (2) mountain-brush, (3) sagebrush-grass, (4) riparian, (5) marshland, and (6) agricultural land groups.

This breakdown permits only a general review of the plant-animal relationships involved, and no inference is made that an ecosystem analysis has been attempted.

The existing environment is a product of both natural biotic conditions and man's cultural activities. These activities include the presence of man specifically in terms of the number of individual people coming in actual contact with wild animal species, the number of domestic animals interacting with the natural environment, the present transportation systems and their use in the area now, mining activities now in process, and urban encroachment resulting from increased population in the study area.

A total of 75 species of mammals, 272 species of birds, 13 species of reptiles, and 6 species of amphibians have been identified by habitat type and season of use for the study area. The complete listing is on file with the Task Force. The more common species and those of significant interest are discussed in this section. A partial listing of species is given in table 1-19.

Although a relatively large amount of information is available for many of the specific wild animal species present, little quantifiable information is available for others. Further, the information that is available has often been gathered by area units that generally do not conform directly to the boundaries of the study area. To the extent possible, the animals involved have been described by individual species or grouping of animals, and the information relative to them has been quantified where possible.

Table 1-19.--Selected wildlife species in the study area

MAMMALS

Common Name	Scientific Name
Black bear	*Ursus americanus*
Shorttail weasel	*Mustela erminea*
Longtail weasel	*Multela frenata*
Mink	*Mustea vison*
Badger	*Taxidea taxus*
Striped skunk	*Mephitis mephitis*
Coyote	*Canis latrans*
Red fox	*Vulpes fulra*
Mountain lion	*Felis concolor*
Bobcat	*Lynx rufous*
Canada lynx	*Lynx canadensis*
Yellowbelly marmot	*Marmota flaviventris*
Richardson ground squirrel	*Citellus richardsoni*
Uinta ground squirrel	*Citellus armatus*
Golden mantled squirrel	*Citellus lateralis*
Least chipmunk	*Eutamias minimus*
Yellow pine chipmunk	*Eutamias amoenus*
Northern pocket gopher	*Thomamys talpoides*
Beaver	*Castor cawadensis*
Deer mouse	*Peromyscus maniculatus*
Muskrat	*Ondatra zibethica*
Bushy-tailed wood rat	*Neotoma cinera*
Porcupine	*Erithizon dorsatum*
Snowshoe hare	*Lepus americanus*
Whitetail jackrabbit	*Lepus townsendi*
Mountain cottontail	*Sylvilagus nuttalli*
Elk	*Cervus canadensis*
Mule deer	*Odocoileus hemionus*
Moose	*Alces alces*

BIRDS

Turkey vulture	*Cathartes aura*
Red-tailed hawk	*Buteo jamaicensis*
Swainson's hawk	*Buteo swainsoni*
Marsh hawk	*Circus cyaneus*
Golden eagle	*Aquila chrysuetos*
Prairie falcon	*Falco mexicanus*
Peregrine falcon	*Falco peregrinus*
Sparrow hawk	*Falco spariverius*
Goshawk	*Accipiter gentilis*
Blue grouse	*Dendragapus obscuras*
Ruffed grouse	*Bonasa umbellus*

Table 1-19.--Selected wildlife species in the study area--Continued

BIRDS

Common Name	Scientific Name
Sage grouse	*Centrocercus urophasianus*
Mourning dove	*Zenaidura macroura*
Great horned owl	*Buba virginianus*
Long-eared owl	*Asio atus*
Common nighthawk	*Chordeiles minor*
Belted kingfisher	*Megacergle alcyon*
Bohemian waxwing	*Bambycilla garrula*
Loggerhead shrike	*Lannus ludoricianus*
Yellow warbler	*Dendroica petechia*
Western meadowlark	*Sturnella neglecta*
Western tanager	*Piranga ludoviciana*
Cassin's finch	*Carpodacus cassinii*
Green-tailed towhee	*Chlorura chlorara*
Vesper sparrow	*Pooecetes gramineus*
Red-shafted flicker	*Colaptes cafer*
Downy woodpecker	*Dendrocopos pubescens*
Violet-green swallow	*Tachycineta thalassina*
Black-billed magpie	*Pica pica*
Common raven	*Corvus coraz*
Common crow	*Corrus brachyrhnchos*
Black-capped chickadee	*Parus atricapillus*
Robin	*Turdus migritorius*
Western bluebird	*Sialia mexicana*
Dipper	*Cinclus mexicanus*
Green-winged teal duck	*Anascarolinensis*
Mallard duck	*Anas platyrhynchas*
Redhead duck	*Aythya americana*
Pintail duck	*Anas acuta*
Common goldeneye duck	*Bucephala clangula*
Gadwall duck	*Anas strepera*
Great blue heron	*Ardea heroidias*
Greater sandhill crane	*Grus canadensis*
Canada goose	*Brawta canadensis*
Long-billed curlew	*Numenius americanus*
Common snipe	*Capella gallinago*
Spotted snipe	
Willet	*Catoptrophorus semipalmatus*
California gull	*Larus californicus*
Franklin's gull	*Larus pipixcan*

Table 1-19.--Selected wildlife species in the study area--Continued

Common Name	Scientific Name
AMPHIBIANS	
Tiger salamander	Ambystama tigrenum
Western toad	Bufo boreas
Leopard frog	Rana pipiens
REPTILES	
Sagebrush lizard	Sceloporus graciosus
Gopher snake	Pituophis melanoleucus
Western gartersnake	Thamnophis elegans
Racer	Coluber constrictor
Common garter snake	Thamnophis sirtalis

The available information relating to the major big game species is discussed in terms of Idaho Fish and Game Department Big Game Management units, (see fig. 1-22), and that for small game species by counties as compiled by that agency. Common names of plants and animals are used throughout the text.

Elk are mentioned in the early literature of this area and appeared to be quite numerous. This is significant and helps identify these animals as being an important game species that tends to persist over a long period of time, owing mainly to the continuing presence of their food supply.

The habitat for elk in the study area, then, identifies their increasing importance. Elk are still distributed generally throughout the six big game management units in the study area, excluding the larger farming and urban areas. These animals are most numerous in game management units 76, 66, 66A, and 69, along the major north-south divide area parallel to the Idaho-Wyoming border. The Idaho Fish and Game Department estimates approximately 2,500 elk winter in the 4 management units; they do, however, shift between management units during summer and winter periods. An example would be the majority of the elk in unit 66 and 66A spend the summer there, and winter in unit 69. When on the winter range area they are more vulnerable to human encroachment than those of the remote areas of northern Idaho.

Management data indicates that elk can increase in number in the study area to the point that they conflict too greatly with other land use values. Depredation complaints in the early 1970's together with wintering counts of over 500 elk in game management unit 66 and over 900 in game management unit 69 caused the Idaho Fish and Game Department to reduce the size of these herds substantially. According to Idaho Fish and Game Department, the elk wintering population in the study area at that time probably exceeded 3,000 animals. They estimate the existing critical winter range can support about 3,000 elk, and that through acquisition of additional critical winter ranges this population could be expanded to 4,000 animals without creating undue problems. Alterations of elk winter range, summer range, calving areas or migration routes will effectively lower these population estimates.

Elk are widely distributed over their summer range, which is mainly related to the conifer-aspen vegetative type. Their intermediate and early winter range is usually associated with the mountain brush vegetative type. See map 7 for the location of these two general vegetative types.

The preferred critical elk wintering areas are generally in the sagebrush-grass vegetative type. Heavy snow causes them to concentrate on open side slopes and exposed ridges that are characterized by westerly exposures with access to cover. The critical elk winter range in the study area, as shown in map 8 is not definitive, but it does generally show known wintering areas. Known, specific, and important elk wintering areas are listed below. Other important elk wintering areas undoubtedly exist in the study area.

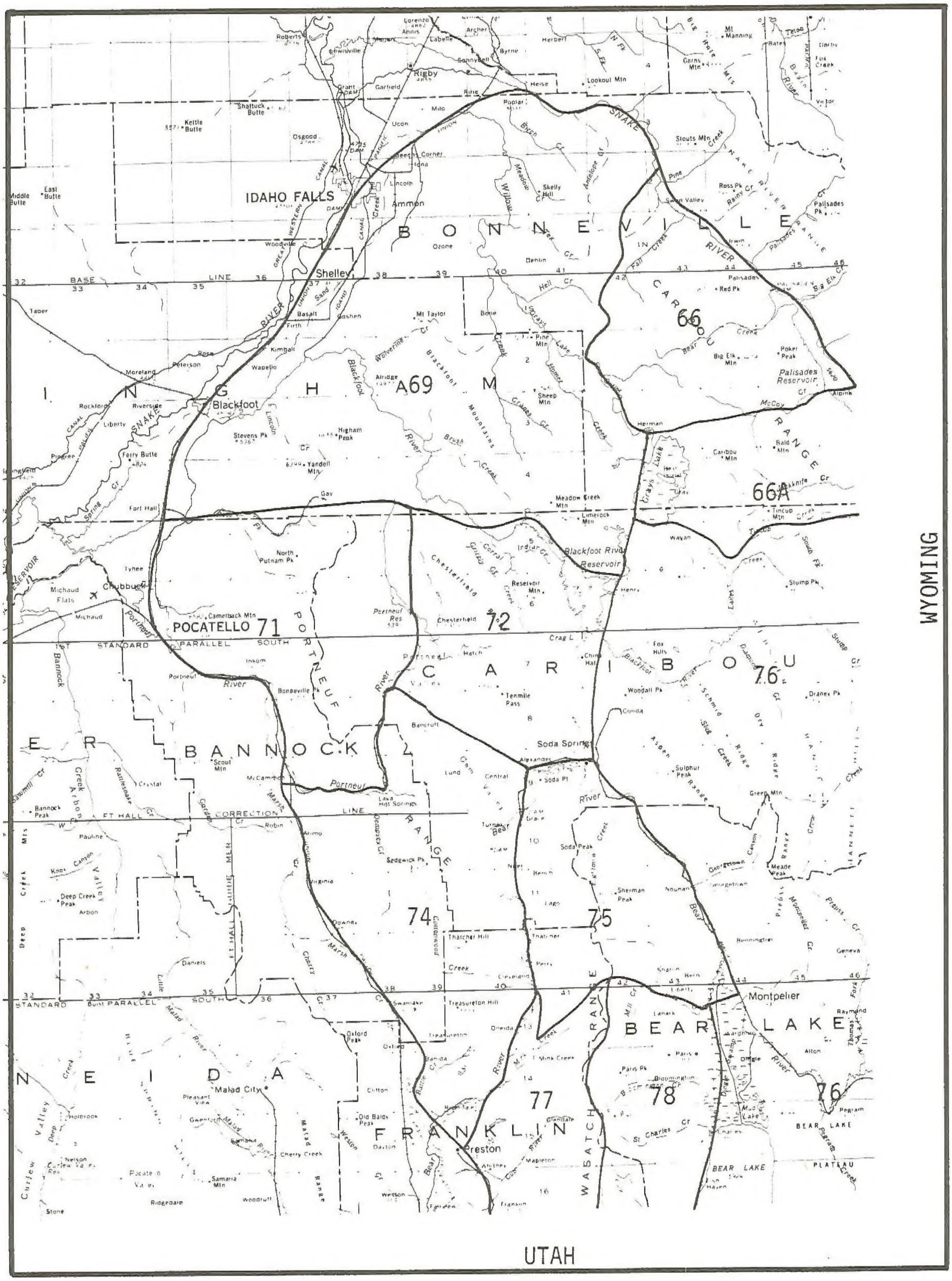

Figure 1-22.--Big-game management units of Idaho Department of Fish and Game.

Unit 66 and 66A	Unit 69	Unit 76
Fall Creek Basin	Taylor Creek	Stump Creek
Commissary	Grays Lake Outlet	Diamond Creek
4th of July Ridge	Tex Creek-Bull Fork	Slug Creek
June Cr.-Gibson Creek	Hell Creek	Blackfoot Narrows
Gibson-Indian Camp	Willow Creek	Bacon Creek
South Fork Fall Creek	Meadow Creek	Geneva Summit
McCoy Creek		Crow Creek
Black Mountain		South Fork Tincup
Jacknife Creek		

Source: Idaho Fish and Game Department

Grass and forbs are important components of the summer elk diet, and grass is a major component of the spring diet. Browse species including sagebrush, bitterbrush, mountain mahogany, serviceberry, and juniper are used increasingly through the fall months, and are included as the main constituents of the diet during the winter months. Depredation complaints are usually caused by elk use of emerging winter wheat stands in the northern part of the study area and haystack depredation in the southern part of the area.

Elk migration routes in the study area are often complex. Some short routes have been observed, some are being studied but the majority of them are unknown especially details related to specific routes, time of year and vegetative areas utilized. Such information is necessary for preparing meaningful land use plans.

Calving occurs on winter, spring, and summer ranges. Known calving grounds in the study area are shown on map 8. One of the largest is on the east side of Dry Valley in unit 76. Favored calving areas appear to be in the sagebrush-grass vegetative type adjacent to conifer-aspen areas. Additional unidentified calving areas undoubtedly exist in the study area.

Mule deer are the most important big game species in Idaho in terms of total animals harvested and hunter participation. They are present throughout most of the state where suitable shrub vegetation is present.

Although early records tend to be conflicting, it is generally agreed that mule deer were not plentiful in southeastern Idaho in the early nineteen hundreds. Since that time a slow increase has taken place and by the 1930's, mule deer numbers increased to the point where a limited hunt was established. By the late 1950's as a result of a continued increase in their number, two-deer hunts were initiated in portions of the study area in an attempt to stabilize these populations. The reason for this dramatic increase in deer numbers is uncertain, but it is believed to have taken place in response to a change in composition of the vegetation. A much larger proportion of native grass was believed present originally in the study area. With the advent of large numbers of domestic animals and increasing competition for the available grass forage, the character of the plant communities changed from that a high proportion of grass to that of shrub vegetation which is more suitable as winter forage for mule deer. By properly managing the deer and domestic livestock, the desirable plant species composition can be maintained. Thus, the potential for continued high mule deer numbers in the study area is present. Providing that no major change in amount of habitat takes place Idaho Fish and Game Department anticipate that a wintering population of 19,000 animals could be maintained in the study area, and a yearly harvest of 5,000 deer, approximately equal to that prior to 1964, could be achieved. Data on deer populations for the Game Management Units primarily affected by the proposed phosphate development are shown in table 1-20.

However, according to the Idaho Fish and Game Department, the 1974 population of deer in the study area is estimated at 16,000, somewhat below the desired objectives of 19,000. Several factors have played an important part in this reduced figure. Mule deer populations have fluctuated over the past 100 years due to variations in habitat, climatic conditions, reproduction and survival success. This phenomena is not limited to Idaho. Adjacent states also have indicated the deer herds are below desired levels and have been on the decline for the past few years. Currently there is a one-deer bag limit with an average season of 3 to 4 weeks for the study area.

Mule deer are more widely distributed throughout the study area than are elk, and range throughout the coniferous-aspen and mountain brush vegetative types during the summer months. The critical winter range of these animals is located in the sagebrush-grass vegetative type upwards into the mountain brush vegetative type where southerly exposures and reduced snow depths permit movement of these animals.

In portions of the study area, barriers such as large expanses of agricultural land, and snow depth preclude the movement of mule deer to further lower elevations. Thus, during severe winters their available range often is reduced to less than fifty percent of its normal size. These key winter areas are a major limiting factor in determining population levels. The more important specific wintering areas are listed in table 1-21.

The food habits of mule deer vary between summer and winter. On summer range they eat a wide variety of shrubs, grasses, and forbs. On winter range sagebrush is the most important forage species. Other shrubs that become important locally include bitter brush, serviceberry, and curl leaf mountain mahogany.

Mule deer tend to use the same wintering areas year after year. Thus, well developed migration routes have been established and tend to be used even if partially blocked. This tendency tends to limit their winter range and ultimately their number. Known major mule deer

Table 1-20.--Deer populations

Year	Computed Harvest	Winter Census	Herd Composition
		Unit 66	
1968	--	3,334	1973 - 1974
1969	1,769	--	Bucks - 5
1970	2,123	2,007	Does - 52
1971	1,393	--	Fawns - 48
1972	843	--	
1973	536	--	Fawns:100 Does - 91:100
			Bucks:100 Does - 10:100
			Total sample size - 105
		Unit 69	
1968	--	2,339	1973 - 1974
1969	637	--	Bucks - 40
1970	563	2,410	Does - 139
1971	1,304	--	Fawns - 88
1972	826	--	
1973	366	--	Fawns:100 Does - 62:100
			Bucks:100 Does - 28:100
			Total sample size - 267
		Unit 72	
1969	620	712[1]	
1970	375	742[1]	no
1971	291	--	
1972	293	--	data
1973	322	576[1]	
		Unit 76	
1969	4,223	6,651[1]	1973 - 1974
1970	6,017	5,695[1]	Bucks - 19
1971	2,910	--	Does - 121
1972	1,228	3,065[1]	Fawns - 107
1973	1,457	2,500[1]	
1974	--	2,496[1]	Fawns:100 Does - 88:100
			Bucks:100 Does - 16:100
		Unit 78	
1969	673	--	1973 - 1974
1970	1,899	1,925[1]	Bucks - 62
1971	656	1,759[1]	Does - 222
1972	286	1,005[1]	Fawns - 237
1973	490	--	
			Fawns:100 Does - 66:100
			Bucks:100 Does - 22:100

[1] Trend counts only.

Source: Idaho Fish and Game Department

Table 1-21. --Deer wintering areas

Unit 66

Cow Camp-Junes Cr.
Commissary
Garden Creek
Pritchard Creek
4th July Ridge
June Cr.-Gibson Creek
Gibson-Indian Camp
Indian Camp to South Fork Snake
South Fork Snake to South Fork Fall Creek
South Fork Fall Creek
Papoose Creek
Squaw Creek
Indian Creek
Girl Scout Flat
Bear Creek
Caribou-McCoy, Upper
Lower McCoy
Jack-knife

Unit 69

Meadow Creek
Antelope
Blackfoot-Wolverine Junction
Wolvering Burn
Narrows Rim
Canyon Burn-Wolverine Face
South Rim
Miner Creek
Schoolhouse Ridge
Dry Washes
Henry-Taylor
Elkington
Outlet
Hell Creek
Kepp's Crossing
Kepp's to Bull Fork
Bull Fork
Bull Fork to Meadow Creek

Unit 72

Soda Springs to Alexander
Idaho Ranch Canyon
Swenson Canyon
Little Flat
Monroe
Eighteen Mile
Swenson to Ten Mile

Unit 76

Sulphur Proper
Rabbit Hill & Cedars
Sulphur to Swan Lake
Diamond-Nine Mile
Rattlesnake-Red Pine
Stump Creek
Stump Gap-Buck Mt.
Browns-Timothy
Deer Creek
Smith-Limekiln Swab
Miller
W. Henry (Whitlocks)
Crow Creek
Georgetown-Dell
Dunn-Montpelier
Montpelier Canyon
Bear Hollow-Pegram
Meckley Lake-Ut.Line

Unit 78

Utah Line to Fish Haven
Fish Haven Canyon
Green Canyon
St. Charles (Main)
St. Charles Dry
Worm Creek
Bloomington
Bloomington Dry
Paris Canyon
Mill Canyon

migratory routes are shown on map 8.

White tailed deer were released in the Heise, Idaho area a number of years ago. They are now present in limited numbers along the northern edge of the study area. They appear to be confined to the bottomland portions of the South Fork of the Snake River, from approximately Palisades Reservoir downstream to the town of Roberts, Idaho. Any reduction in habitat will reduce both mule deer and white-tailed deer populations.

Early historical records make little mention of moose; however, they are believed to be indigenous to the study area. Moose populations were apparently low in southeast Idaho at the turn of the century but have gradually increased in number. Moose are presently found scattered throughout the entire area, with the exception of the urban and cultivated agricultural areas. They prefer the coniferous-aspen, mountain brush, and the riparian vegetation types. Willow areas within the riparian type receive considerable use as in Diamond Creek drainage. Other areas preferred by moose in the study area include the Grays' Lake drainages, Slug Creek, Crow Creek drainage, Georgetown Canyon, McCoy Creek, Jackknife Creek, Fall Creek, Pruess Creek, Lanes Creek, Montpelier drainages, Skyline Ridge, Meadow Creek, Antelope Creek and Dry Valley. Specific moose migrations are not known but they seem to winter wherever suitable forage is available. Snow depth generally present in the study area is apparently no problem to moose, and food availability is one of the major criteria in winter range selection. Important forage species besides willow include bitterbrush, chokecherry, serviceberry, ceanothus, mahogany, grasses, and sedges.

During a 1973-74 winter aerial survey, the Idaho Fish and Game Department counted 69 moose in units 66 and 69, and 50 animals in unit 76. This, however, is not a complete count of the population as it was taken incidental to elk and deer surveys. This area provides about 32 percent of the statewide moose hunting permits, and includes some of the better moose habitat in the State of Idaho.

Black bear were fairly common in the study area prior to the 1900's when grazing began. Since then a continual open season and indiscriminate killing has kept them at low density.

The mountain lion is present in the study area but its status and numbers are unknown. Game management unit 66 and 69 are presently closed to hunting lion. The rest of the study area has a fall and winter hunting season.

Wolverine, buffalo, antelope, grizzly bear, wolves and mountain sheep were reported by early trappers as being common throughout this area and particularly in the Portneuf River valley. Mountain sheep were also reported present in the Bear River valley area. From early journals, it is known that the buffalo had largely disappeared from this area by 1860. From all that can be learned, antelope and mountain sheep became scarce in the 1870's and continued to diminish in numbers through the 1930's and 1940's. In 1944, 52 head of antelope were seen in Dry Valley on the Caribou Forest, but none have been seen since that time. The last Bighorn sheep were seen in 1960 in the Crow Creek drainage. Wolverine have been unreported since 1925.

No studies have been made to determine the feasibility of reintroducing any of these species. There appears to be some suitable habitat for the reintroduction of mountain sheep. At this time there does not appear to be any suitable areas for the reintroduction of grizzly bear, antelope, buffalo, wolverine, or the timber wolf; however, one grizzly bear was killed four miles from Heise in 1973.

Although the size of small game populations have not been determined numerically, their relative importance can be determined by hunting pressure and birds harvested. Thus, hunter questionnaire information supplied by the Idaho Fish and Game Department listing total number of hunters, hunter days, kill, and birds per hunter-day has been used to indicate small game hunting activity in the study area.

Sage grouse, the largest native North American grouse, at one time inhabited the study area in large numbers. Today, due to destruction of portions of its habitat including wintering areas, booming grounds, nesting areas, and summer brood rearing areas, this species has been greatly reduced in number. The conversion of sagebrush areas to agricultural lands and grass for domestic stock is considered largely responsible. The preferred habitat of this species is the sagebrush-grass vegetative type in association with stream bottoms where water and suitable meadow areas with succulent vegetation for brood rearing purposes are available.

Important sage grouse summer nesting and brood rearing habitat in the study area is found in the Tex Creek, Dan Creek, Hall Creek, Coral Creek, Slug Creek Rasmussen Valley, Paris-Liberty Area, Fall Creek Basin, Commissary Ridge, Caribou Basin, Meadow Creek, Crane's Flat, Gray's Lake outlet area, and Dry Valley drainages. Important sage grouse habitat is also found in the Bear River drainage. The more important known sage grouse strutting areas in the study area are listed in the following table.

SAGE GROUSE STRUTTING GROUNDS

County	Site
Bear Lake	Paris-Liberty
Bear Lake	Geneva Cemetery
Caribou	Long Valley
Caribou	Wooley Valley
Caribou	Slug Creek
Caribou	Corral Creek
Caribou	Angus Creek
Bonneville	Long Valley

Source: Idaho Fish and Game Department

Nesting sites are usually selected near the strutting ground, with 80 percent of the nests occurring within a two-mile radius of the strutting ground. Harvest data showing the relative importance of this species is listed in the following table.

SAGE GROUSE AND SHARPTAILED GROUSE

Yr.	Total Hunters	Total Hunting Days	Total Kill	Success--Birds/day
1971	2,666	4,685	4,685	1.00
1972	3,420	3,420	6,250	1.82
1973	6,363	6,663	14,540	2.28

Data are for Bear Lake, Bingham, Bonneville, and Caribou Counties
Source: Idaho Fish and Game Department

Based on historical accounts, the sharptailed grouse was once extremely numerous in southeastern Idaho. This species is primarily associated with grass communities mixed with the mountain brush vegetative type. It apparently decreased in number in direct proportion to the loss of habitat by removal for agricultural purposes and as the remaining grasslands changed to predominantly sagebrush and related species as a result of over-grazing. Any further loss of this habitat would further reduce the range of this species. In recent years, some increase in sharptailed grouse numbers has taken place in the Bone, Idaho area and Coral Creek-Ten Mile Pass area-near Soda Springs, Idaho. This increase is believed due to the conversion of sagebrush grass rangeland. Schrub species including chokecherry, bitterbrush and serviceberry, which are important constituents of sharptailed grouse habitat, are found along the streams and gullies in and adjacent to these farming area. The known locations of these birds in the study area are shown on map 8. The exact location of the dancing grounds of these birds is unknown. The sharptail grouse harvest is combined with the sage grouse harvest.

Two species of forest grouse, blue and ruffed grouse, are common throughout the mountainous portion of the study area. Blue grouse inhabit the conifer-aspen, mountain brush, sagebrush-grass, and riparian vegetative types. This species exhibits an upward elevational movement from summer to wintering areas. Blue grouse nest on grassy open slopes and ridges and this habitat type is usually found at elevations below the mature coniferous forested areas that is needed for wintering purposes. They depend on the needles of conifers for winter food. Old over-mature Douglas Fir trees that are located on or near ridge tops are usually preferred. Ruffed grouse within the study area are generally found in the coniferous-aspen, mountain brush, and riparian vegetative types. Although these birds use a variety of food species during much of the year, they feed largely on buds of aspen and various other deciduous species during the winter period. Both blue and ruffed grouse are increasing in popularity with hunters, and provide a substantial recreational opportunity as indicated in the following table:

FOREST GROUSE

Yr.	Total Hunters	Total Hunting Days	Total Kill	Success-- Birds/day
1971	2,386	8,191	10,685	1.30
1972	3,076	10,380	15,332	1.48
1973	2,857	13,152	13,431	.99

Data for Bear Lake, Bingham, Bonneville, and Caribou County.
Source: Idaho Fish and Game Department

The chukar partridge, an introduced species, is found east of Bear Lake and in the northwest part of the study area. Fairly large numbers occur in limited areas of suitable terrain such as rocky ridges and related talus slopes. Its relative importance as a small game species is indicated by the Idaho Fish and Game Department hunter questionnaire data in the following table:

CHUKAR PARTRIDGE

Yr.	Total Hunters	Total Hunting Days	Total Kill	Success-- Birds/day
1971	646	1,668	2,792	1.67
1972	1,101	2,523	1,993	.79
1973	1,281	3,694	4,510	1.22

Data for Bear Lake, Bingham, Bonneville, and Caribou Counties
Source: Idaho Fish and Game Department

The Hungarian partidge, also an exotic species, is scattered throughout the study area in a variety of habitat types limited to lower elevations. These birds are most often found in areas where dryland agricultural grains crops are intermixed with native brush stands. Its relative importance is shown in the following table:

HUNGARIAN PARTRIDGE

Yr.	Total Hunters	Total Hunting Days	Total Kill	Success Birds/day
1971	1,269	2,747	4,071	1.71
1972	946	1,985	3,113	1.56
1973	1,425	6,917	6,891	.99

Source: Idaho Fish and Game Department

The pheasant, also an introduced species, is associated directly with agriculture and particularly with the growing of alfalfa and cereal grain crops in the study area. Because of lack of suitable habitat, it is not an important species relative to the present study.

Snowshoe hare inhabit all coniferious-aspen habitat types in the study area.

White-tailed jackrabbits are found throughout the sagebrush-grass and along the edges of agricultural cover types of the study areas. They are hunted during the winter.

Both the cottontail and pygmy rabbits are found in the study area. The cottontail is the most numerous, and inhabits almost all habitat types with the exception of the coniferous-aspen type at higher elevations. The largest concentration of cottontail rabbits is considered to be in the lowland riparian areas and in the sagebrush-grass community. The pygmy rabbit is also a relatively important game species, as indicated by the Idaho Fish and Game Department hunter questionnaire data listed in the following table:

COTTONTAIL AND PYGMY RABBITS

Yr.	Total Hunters	Total Hunting Days	Total Kill	Success Rabbits/day
1971	1,872	7,801	12,434	1.59
1972	1,908	8,542	9,219	1.08
1973	2,174	8,303	5,903	.71

Data for Bear Lake, Bingham, Bonneville, and Caribou Counties.
Source: Idaho Fish and Game Department

The mourning dove, a migratory species, is found throughout the study area during the summer months. It is associated mainly with the sagebrush-grass, mountain brush, riparian and agricultural areas.

The study area is located in the Pacific waterfowl flyway. Over a million waterfowl migrate through the study area during the spring and fall migrations. The fall movements begin in late August and continue through December. As the fall period progresses and freeze-up takes place in the study area, this movement shifts westward. Large numbers of ducks and geese tend to concentrate at American Falls reservior before moving south as the fall season progresses. Most of the waterfowl habitat in the study area is frozen over during the winter months. A few waterfowl are recorded at Bear Lake National Wildlife Refuge in January and February, but none at Grays Lake National Wildlife Refuge. The spring migratory movement northward begins in late March and continues through April and May.

Mallards and pintails make up approximately one-half of the waterfowl breeding population in the study area. The best production areas are adjacent to small bodies of water such as beaver ponds and large and small streams and marsh areas. Nesting success is high, on some areas such as Grays Lake.

Breeding species on Grays Lake National Wildlife Refuge listed in order of their relative abundance include the mallard, pintail, canvasback, redhead, cinnamon teal, lesser scaup, ruddy duck, gadwall, shoveler, blue-winged teal, green-winged teal, and widgeon. Over 16,000 ducks are produced annually in this area.

The importance of this wildlife resources is indicated by data listed in the following table. Mallards usually comprise more than half of the indicated harvest:

		DUCKS		
Yr.	Total Hunters	Total Hunting Days	Total Kill	Success Birds/Day
1971	2,908	17,200	36,938	2.15
1972	3,657	23,136	40,821	1.76
1973	4,492	33,721	53,905	1.60

Data for Bear Lake, Bonneville, and Caribou Counties
Source: Idaho Fish and Game Department

Canada geese breed throughout the study area with known major nesting locations at Grays Lake National Wildlife Refuge, Blackfoot Reservoir, and Bear Lake National Wildlife Refuge. Nesting also takes place at smaller reserviors, and particularly along many of the stream courses in the area.

Canada goose management in Idaho is based on a system of making spring breeding pair counts, nesting counts, and post-nesting production counts on designated areas. These data over a period of years give trend information on both the breeding population and production success. Over 3,500 Canada geese are produced annually in the study area. The breeding pair trend count data for locations in the study area are given in the following table:

Area	Indicated Pairs									
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Blackfoot Reservoir	-	210	213	133	116	176	109	213	96	70
Grays Lake	395	208	239	161	164	305	66	197	211	226
Bear Lake NWR	836	698	597	169	281	524	545	185	181	419
Chesterfield	13	15	-	14	17	21	8	46	13	9
Alexander	-	-	-	-	-	9	-	8	-	14
Bear River Soda-Montpelier	-	-	-	-	-	-	30	145	87	240
Upper Blackfoot River	-	-	-	-	-	-	-	-	-	31
Lanes Creek	-	-	-	-	-	-	-	-	-	13
Diamond Creek	-	-	-	-	-	-	-	-	-	6

Source: Idaho Fish and Game Department

These data indicate that the 1974 breeding population was significantly higher in three of the areas over the last year, but still generally below that of the long-term average. The breeding population on Blackfoot Reservoir shows a continuing downward trend, however, with the count in 1974 being the lowest on record during the last 10 years. Increased use of this area by fishermen and other water users is believed to be a principal reason for this decline.

Several nesting and gosling production trend areas, Blackfoot Reservoir, Grays Lake, Chesterfield, Blackfoot River are located in the study area. As suggested by the breeding pair count data, both the number of nesting attempts and gosling production, according to the Idaho Fish and Game Department, has continued to decline at Blackfoot Production is apparently increasing elsewhere in the study area. Available data suggest that many of the nesting geese are moving from Blackfoot Reservoir to the Blackfoot River and other tributaries. In 1975, the Idaho Fish and Game Department counted 313 geese on the upper Blackfoot River, Diamond Creek, Slug Creek, and Bear River between Soda Springs and Montpelier.

Canada geese are hunted extensively in the study area, and are considered a trophy species. Their relative importance in terms of numbers harvested is shown in the following table:

CANADA GEESE

Yr.	Total Hunters	Total Hunting Days	Total Kill	Success--Birds/day
1971	2,257	9,905	8,571	.87
1972	2630	11,546	3,868	.34
1973	2,575	12,863	1,933	.15

Data for Bear Lake, Bonneville & Caribou Counties
Source: Idaho Fish and Game Department

Small numbers of snow geese and lesser Canada geese migrate through the area in spring and fall. No information is available on the magnitude of this movement. No snow geese or lesser Canada geese were observed on the study area during either the 1973 or 1974 mid-winter waterfowl counts.

The breeding range of the trumpeter swan once ranged throughout the northwest and central parts of North America. Because of heavy exploitation of these birds in the central part of North America, they were on the verge of extinction in that area. Efforts to preserve this segment of the population was initiated in 1935 when Red Rock Lakes Migratory Waterfowl Refuge in Montana was acquired. Trumpeters from that group have expanded their breeding range, and limited numbers have been known to nest at Grays Lake National Wildlife Refuge in the study area. The breeding habitat of these birds is quite specific, and potential exists for expansion of range. Habitat requirements are as follows:

1. Stable waters possessing a relatively static level, not exhibiting marked seasonal fluctuations.
2. Quiet waters of lake, marsh, or slough, not waters subject to obvious current or constant wave action.
3. Shallow waters of lakes or open marshes, not so deep as to preclude considerable digging and foraging for lower aquatic plant parts, roots, tubers, etc.
4. Minimum human disturbance and relatively remote areas.

Whistling swans regularly use both Grays Lake and Bear Lake Refuges as resting areas during spring and fall migrations. During the southward fall migrations, the first swans arrive in the study area usually during the second week of October, and reach peak numbers in the latter part of November before moving farther south to their regular wintering areas. There is no known nesting of whistler swans in the study area.

Beaver have historically been recognized as one of the most important wildlife species in southeastern Idaho in terms of man's interests in wildlife. Man's first presence in the study area during the early 1800's documented the presence of beaver. Beaver abundance fluctuates with habitat availability and trapping pressure. Beaver colony trend counts are used by the Idaho Fish and Game Department to determine population trends and distribution of these animals. The major problem in beaver management is that of balancing the number of beaver to their food supply. The Idaho Fish and Game Department estimates that 1,535 beaver were harvested in 1974 in Bear Lake, Bonneville, and Caribou Counties.

The most important muskrat habitat in the study area includes Dingle Marsh, Grays Lake, Elk Valley, and Woodall Marsh. Streams such as Diamond Creek, Slug Creek, Lanes Creek, and Brockman Creek and associated wetland areas also provide good habitat. In addition, Blackfoot River above Blackfoot Reservoir and Bear River between Bear Lake and Alexander Reservoir also contain good muskrat habitat. Muskrat habitat is often associated with old beaver dams. Permanent aquatic environments associated with emergent vegetation such as cattails, bullrushes, and sedges provide the necessary habitat for this species. A significant muskrat harvest occurs on all streams within the study area. The Idaho Fish and Game Department estimates that 16,400 muskrats were harvested in 1974 in Bear Lake, Bonneville, and Caribou Counties.

Otter are present in the study area but their status is unknown. Some recent sightings have been made below Palisades Reservoir along the Snake River. They also inhabit the Bear River drainage. Marten are present in the study area but their status is unknown. They are mainly dependent upon the coniferous forested areas for their habitat requirements. Mink are also found in most water areas of the study area.

There are 65 mammalian non-game species in the study area. Although little is known about this group of animals in terms of their life habits, they are one of the more important vertebrate species present. This group, including mice, voles, and ground squirrels, constitutes the food base for a number of wildlife species higher in the food chain.

There are 25 species of raptors that inhabit the area year long or at some time during each calendar year. Two of the more important birds of prey in the study area are the peregrine falcon and the prairie falcon.

About 100 pairs of golden eagles inhabit the area. They are primarily found throughout the areas where the highest density of their prey species occur. A decimating factor on the golden eagle as with other raptors is when the development of lands reduce their primary prey species and nesting areas.

The bald eagle inhabits the area in varying numbers, depending on the season of the year. Summer populations are found scattered throughout the area, and it is estimated that there are approximately ten pairs present with at least five known active nests. The winter population of the bald eagle is estimated to be approximately 100 birds from Palisades Reservoir downstream along the South Fork of the Snake River to the town of Roberts, Idaho and approximately 50 near the Bear River area. Others are scattered throughout the study area.

Other birds of prey include the osprey, goshawk, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, Swainson's hawk, rough legged hawk, ferruginous hawk, marsh hawk, pigeon hawk, and sparrow hawk. Owls within the area include the barn owl, screech owl, flammulated owl, burrowing owl, great gray owl, great horned owl, long-eared owl, and saw-whet owl.

These birds of prey subsist mainly on the small rodents, fish, reptiles, and amphibians, carrion, and an occasional ungulate. Shrubs, trees, and cliffs provide cover and nesting sites for most of the species. In open country, utility poles, fence posts, snags, and other isolated structures provide important perches for nesting and hunting raptor. Raptors are important in the overall predator-prey relationships, acting as one of the regulating influences on prey populations. Within the study area, alteration of habitat by man appears to be the greatest threat to the birds of prey. Turkey vultures, ravens, magpies and crows are also common throughout the study area.

The area contains one of the largest greater sandhill crane nesting populations in North America. This species has been greatly reduced from historic numbers. These birds are highly territorial and return to the same territories in reparian habitats. The nesting and brood rearing requirements of this species are generally located within the established breeding territories along marshy edges. The 1975 spring population at Grays Lake was estimated at 1,000 birds. The total population within the study area is approximately 4,000 during the fall migration.

In addition to greater sandhill cranes, a large variety of birds, including herons, egrets, terns, rails, ibis, and bitterns are attracted to the riparian areas. Nesting birds include double-crested cormorants, snowy egrets, white-faced ibis, Franklin and California gulls, grebes, Forster's and black tern. Longbilled curlews, Wilson's snipe, Great blue heron, black-crowned night heron, American bittern, coot, willet, American avocet and yellowlegs have also established breeding grounds within the study area. Franklin gulls nest in several large colonies in bullrush habitat throughout this region. Franklin gulls have a voracious appetite for insects, making them extremely beneficial to agriculture. Black tern, Wilson's snipe, sora and Virginia rails nest in large numbers among the dense marsh vegetation. Other shorebirds found in the area include phalarope, stilts, sandpipers, killdeer and plover.

Numerous song and insectivorous birds inhabit all vegetative types within the area. Most are migratory; some are year-round residents. Each habitat type attracts certain species of birds. The most common insectivorous birds include the Say's phoebe, western meadowlark, and the western kingbird, swallows and night hawks. There is little information concerning densities, distribution, and other factors relating to song and insectivorous birds in the area. However, it is known that some of these avian species constitute a large portion of certain raptor's prey items.

A total of 14 species of reptiles and 6 species of amphibians are known to occur in the study area. The amphibians are frequently found in quiet waters of ponds, reservoirs, lakes, and streams from the marshlands to the mountain meadows and forests. Several species of invertebrates and insects are utilized for food by the animals.

The only poisonous reptile in the subject area is the western rattlesnake which occurs from the valley bottoms to the lower elevations in the coniferous-deciduous vegetation types. It does not occur at the higher elevations. Principal prey species are small animals such as mice and rats, birds, lizards, and frogs. The remainder of the reptiles prey upon insects, and other reptiles, frogs, toads, snails, and spiders.

THREATENED AND ENDANGERED SPECIES

The Endangered Species Act of 1973 officially recognizes two categories of animals that are in danger of extinction or severe reductions in numbers. These are the (1) Endangered Species, and (2) Threatened Species. The endangered list has been completed but no comparable threatened list has as yet been officially published.

Although most of the popular wildlife species distribution show the range of the spotted bat extending into southern Idaho, there are no known authenticated records of spotted bats having been collected.

The Northern Rocky Mountain wolf, Canis lupis irremotus, officially listed as an endangered species, was sighted in the study area in 1971. It is also listed as present in Wyoming across the state line. Thus this species may occasionally be in the area.

The grizzly bear, a threatened species, has declined in the area since 1920. According to the Idaho Department of Fish and Game, the tracks of one were seen in the fall of 1974 in Stump Creek. No known stable populations occur in the study area.

The prairie falcon occurs in the area. Field falconers and professional ornithologists estimate that there are at least twenty-five breeding pairs of these birds within the area. Ten known active nests and their locations have been recorded. This falcon was listed on the 1973 list of threatened species by the Secretary of the Interior. Its official status under the new Endangered Species Act has not been determined. The prairie falcon inhabits primarily the sagebrush-grass habitat type where most of its prey species is found. Its nests are located in cliff areas.

The American peregrine falcon, Falco perregrinus anatum, is known to inhabit the study area. Four breeding pairs are believed present, although only two active nests have been identified. The peregrine falcon habitat seems to be related directly to the riparian and marshland vegetative types. The primary prey of this species are birds such as the passerine group, shore birds, and water-fowl. Man's activities and presence are perhaps the greatest decimating factor for this species. The use of pesticides has adversely affected its breeding capability. Illegal shooting and harassment at its nesting sites take an additional toll, and human disturbance in general near nesting sites is believed to affect their nesting success.

The whooping crane, Grus americana, an endangered species, has been recently introduced into the study area via the foster parent program. Whooping crane eggs were taken from Canada and placed under nesting greater sandhill cranes at Grays Lake National Wildlife Refuge. Fourteen eggs were transplanted in this manner; nine of them hatched. Six young were successfully raised to flight state. These young whoopers have migrated and now (November, 1975) are wintering on the Bosque del Apache Refuge in New Mexico.

It is anticipated that in the future, these birds will follow their parents during migration and eventually set up nesting territories of their own in and around Grays Lake National Wildlife Refuge. Habitat that is available for whooping cranes is located in Diamond Creek, Rasmussen Valley, Crane Flat, Lanes Creek, Dry Valley and Slug Creek. All of these afford suitable sandhill crane habitat and therefore will be suitable whooping crane habitat.

7. FISHERIES

The major drainage systems within the area include the Blackfoot River, Bear River, Salt River, South Fork of the Snake River, and the Grays Lake drainage. These drainage systems provide some of the highest quality fishing in the State of Idaho. Several of the tributary streams are classed as high quality trout streams and support not only high fish populations but also furnish considerable recreational benefits to both residents and non-residents. In particular, the Blackfoot River, formed by Lanes Creek and Diamond Creek, is one of the better known trout streams within the state. The Blackfoot in turn runs into the Blackfoot Reservoir which is well known for its large-sized cutthroat and rainbow trout.

Soils, derived from limestone, shale, sandstone, and chert, provide the nutrients and minerals necessary to maintain high productivity in the aquatic ecosystem. However, individual streams differ in the quality of the fisheries they can support. The aquatic environments vary from good to poor, the lowered quality being caused mainly by low water flows or stress from existing land uses; irrigation return flows and livestock influence are the most degrading factors, but impacts due to mining have been noted in Maybe, Mill, Angus, McCoy, and Georgetown Creeks.

The aquatic environments producing most of the fishery are streams that have been modified by beaver activities. Lakes and reservoirs, because of their large size, are also valuable contributors to the fishery. Because physical and chemical factors are usually favorable to form a productive aquatic habitat, most streams have the potential for providing optimal conditions for the development and maintenance of diverse food webs and excellent fish populations. Some lakes and reservoirs are borderline in offering the necessary requirements for salmonids and often are dominated by undesirable fish. Bear Lake, however, is noted for its populations of lake trout, cutthroat trout, and Bonneville Cisco.

Blackfoot Reservoir (19,000 acres), Blackfoot River and tributary streams are a complex environmental entity where factors that affect one can affect the others. For example, mature rainbow and cutthroat from Blackfoot Reservoir ascend Blackfoot River in May and June to spawn. Rainbow spawn primarily in the Blackfoot River below the Lower Narrows. Cutthroat ascend the main river and spawn in virtually all of the main tributary streams. The eggs are deposited in the stream gravel and hatch approximately 60 days after fertilization. The young fry gradually emerge from the gravel and find protective cover and food in the immediate area of their emergence. They rear in these tributary streams for one to three years and then migrate down the Blackfoot River and into Blackfoot Reservoir. They continue their growth in Blackfoot Reservoir for two to four years when they reach maturity and ascend these tributary streams to spawn. Other trout live and complete their entire life cycle in the stream of their origin.

Any addition of silt, reduction in rearing habitat or passage problems in a particular stream, although it may be small, has the potential to reduce the fish populations in that particular tributary stream, the Blackfoot River and Blackfoot Reservoir. Therefore, any reduction in fish populations in a specific area can affect the entire Blackfoot System.

The Snake River upstream from Shoshone Falls contains two forms of native cutthroat trout. One form, called the large-spotted Snake River cutthroat trout, was at one time uniformly distributed over the entire Snake River Plain from Shoshone Falls upstream to the headwaters of the Snake River near Yellowstone National Park. Today, its range has been somewhat restricted. This trout is distinguished by the presence of large roundish spots concentrated mainly behind the region of the dorsal fin. This fish is present in the Blackfoot River system andvirtually all native fish found there are of this origin. The Henrys Lake origin cutthroat trout mentioned in the draft is this large-spotted Snake River cutthroat trout.

Another form, called the Snake River fine-spotted cutthroat trout, occurs in the South Fork of the Snake River and its tributaries from Jackson Lake downstream. This fish is also common in the phosphate mining unit and occurs in virtually all tributaries of the Salt River or the South Fork of the Snake River in Idaho. This finespotted Snake River cutthroat is propagated by the Wyoming Fish and Game Department and in the past few years plants of this form have been made in Blackfoot Reservoir, Salt River and the South Fork of the Snake River tributaries.

The two mentioned forms of cutthroat trout are the only ones found in the phosphate mining unit. Their distinction is readily apparent upon examination.

Many streams are inhabited by dense populations of Henrys Lake cutthroat and sparcer populations of the Snake River variety of cutthroat trout. The Henry's Lake cutthroat trout originated from the Henry's Lake, Idaho brood stock, and is stocked annually by the Idaho Fish and Game Department throughout the area except in the South Fork Snake River drainage where the Snake River variety is stocked from the Webster Creek hatchery operated by the Wyoming Fish and Game Department. The Snake River cutthroat trout (fine spotted cutthroat trout) is rare in Idaho and receives special consideration in the South Fork Snake River drainage. Occurring in fewer numbers are rainbow trout, brook trout, brown trout, and whitefish.

Because only a few aquatic environments and their fisheries have been studied in detail within the area, full evaluation of the ecosystems is not possible. However, data available to date permit general evaluations of the fisheries of the area and qualitative evaluation of significant streams in the area.

Within the Bear River drainage, cutthroat-trout populations occur in Bear River, Bear Lake Canal, Co-op Creek, Eight-mile Creek, Georgetown Creek, Montpelier Creek, Pearl Creek, St. Charles Creek, Skinner Creek, Stauffer Creek, Thomas Fork Creek, and Whiskey Creek. Cutthroat trout also occur in Bear Lake and Montpelier Creek Reservoir. Rainbow trout are stocked in Bear River, Beaver Creek (Little), Bloomington Creek, Eightmile Creek, Georgetown Creek, Montpelier Creek, St. Charles Creek, Whiskey Creek, and Bear Lake. Other salmonoid and nongame fish species occur in Bear River, Bailey Creek, Bear Lake Canal, Bloomington Creek, Eightmile Creek, Georgetwon Creek, Ledge Creek, Montpelier Creek, Pearl Creek, Snowslide Creek, Spillway (Bear Lake), Thomas Fork Creek, Trail Creek, Whiskey Creek, Bear Lake, and Montpelier Creek Reservoir. Fish Haven, Hot Springs (Bear Lake), and Indian Creek (Bear Lake) do not support fisheries.

The Blackfoot River drainage supports a high-quality cutthroat-trout fishery. Upstream migration to spawning areas in the tributaries, other than a possible restriction at the Allen Ranch Division, has not been restricted by human obstacles, which have seriously limited natural fisheries in other areas. The streams containing cutthroat-trout populations include Angus Creek, Blackfoot River, Davies Creek, Diamond Creek, Grays Lake Outlet (Jensen Cut), Kendall Creek, Olsen Creek, Lanes Creek, Spring Creek, Poison Creek, Sheep Creek, and Blackfoot River Reservoir. Rainbow Trout are stocked in Blackfoot River, and Blackfoot River Reservoir. Other species of salmonoids and nongame fish occur in Angus Creek, Blackfoot River, Diamond Creek, Kendall Creek, Olsen Creek, Lanes Creek Sheep Creek, Slug Creek, Blackfoot River Reservoir, and Wolverine Creek.

Of these creeks, two are of particular note. Spring Creek, a tributary of Diamond Creek, and Sheep Creek, a tributary of Lanes Creek, are extremely important to the cutthroat spawning and rearing areas for the Blackfoot Reservoir. Spring Creek is the most important spawning stream in the Blackfoot system for cutthroat trout. About 1,000 cutthroat trout from the Blackfoot system use Spring Creek for spawning. Both of these creeks are relatively short and are shallow and necessary to the continuation of the fisheries of the Blackfoot River. Both are located adjacent to proposed mining activities within the study area. The Blackfoot River Reservoir species of cutthroat trout is a much sought after trout and specimens of ten pounds or over are not uncommon.

Within the Salt River drainage, cutthroat and brown trout are in Crow Creek and Stump Creek, but rainbow trout are not stocked. Tincup Creek has a good cutthroat-trout fishery; brook trout are also present in some of the beaver ponds from previous stocking programs. The main cutthroat trout in the Salt River drainage is the Snake River variety.

Within the Snake River Drainage, cutthroat-trout occur in Birch Creek, Grays Lake Outlet (North), Mill Creek (Snake drainage), North Canyon (Snake drainage), Portneuf River, Skinner Creek (Snake drainage), and Willow Creek.

Rainbow trout are stocked in Portneuf River and Willow Creek. Other fish species, mainly brook trout, occur in Birch Creek, Gravel Creek, Grays Lake Outlet (North), Portneuf River, and Willow Creek. Good populations of brown trout occur in Portneuf River, Montpelier Creek and Willow Creek drainage.

The aquatic environment and fishery conditions of significant streams in the area are listed in table 1-22. The fishing pressure is moderate to intense in the higher-quality streams (rated 4 or 5 in the table). Streams rated 1 or 2 are seldom used. The stream classification of the Idaho Fish and Game Department is shown in Figure 22a.

Cutthroat trout dominate the resident fishery. This is unusual in that the cutthroat trout is declining in most areas of Idaho because of pollution, over fishing, and replacement by stocked hatchery fish species. However, the Snake River and Utah varieties of native cutthroat trout have been replaced in many environments by the Henrys Lake cutthroat because of hatchery stocking programs. The Snake River cutthroat still occurs in the Salt River drainage and the South Fork Snake River. The Utah cutthroat trout found primarily in Bear Lake and its tributaries may no longer exist. Cutthroat trout presently occur in about three-fourths of the 111 streams for which data are available.

Hatchery stocking has extended the historic range of rainbow trout throughout the study area. Most of the rainbow trout harvest is dependent on annual replenishment from hatchery production. Even with hatchery supplementation, rainbow trout occur in only about one-fifth of these streams. Lake trout are found only in small numbers in Bear Lake. Brown trout are restricted mainly to the Salt River drainage. They occur in about 12 percent of the streams. Brook trout are an exotic and

Table 1-22.--Selected fisheries and fishery conditions within the study area[1]

Stream, lake, or reservoir	Fish species present									Contributes cutthroat to Blackfoot system	Fishery rating[2]	Current environmental influences				Condition			
	Rainbow	Cutthroat	Brook	Brown	Whitefish	Sucker	Dace	Shiner	Sculpin			Livestock[3]	Logging[4]	Roads[5]	Mining[6]	Ephemeral stream	Perennial stream	Resident salmonid[7]	Hatchery salmonid
Angus Creek		X				X	X	X	X	X	4	3	4	5	4		X	X	X
Bacon Creek		X								X	3	3	5	5	5		X	X	
Bear Creek		X					X		X		3	2	5	3	4		X	X	
Bear Canyon Creek		X								X	2	3	5	4	5		X		
Bear Lake	X	X	X		X	X	X	X			4	4	5	5	5		X	--	X
Bear Lake Outlet	X	X	X		X	X	X	X	X		2	4	5	5	5		X	--	X
Bear River	X	X			X	X	X	X	X		3	2	5	5	5		X	--	X
Bear River-Thomas Fork	X	X			X	X			X		3	3	5	5	5		X	--	X
Beaver Dam Creek		X									2	2	5	5	5		X	X	X
Blackfoot River	X	X	X			X	X	X	X	X	5	3	5	5	5		X	X	X
Blackfoot River Reservoir	X	X	X		X	X	X	X			5	4	5	5	4		X	--	X
Bloomington Creek	X	X	X			X			X		4	4	5	5	5			--	X
Books Creek		X									2	3	5	5	5		X	X	
Browns Creek		X								X	2	4	4	3	5	X	X	X	X
Cabin Creek		X								X	3	4	5	5	5	X	X	X	
Clear Creek		X									3	2	4	5	5	X	X	X	
Coyote Creek		X								X	2	3	5	5	5		X	X	
Dry Valley		X								X	2	3	5	4	2	X	X	X	

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[1] Data from Forest Service.

[2,3,4,5,6,7] See footnotes at end of table.

Table 1-22.--Selected fisheries and fishery conditions within the study area--Continued

Stream, lake, or reservoir	Fish species present									Contributes cutthroat to Blackfoot system	Fishery rating[2]	Current environmental influences				Condition			
	Rainbow	Cutthroat	Brook	Brown	Whitefish	Sucker	Dace	Shiner	Sculpin			Livestock[3]	Logging[4]	Roads[5]	Mining[6]	Ephemeral stream	Perennial stream	Resident salmonid[7]	Hatchery salmonid
Crow Creek		X	X	X	X	X	X		X		5	2	4	5	5		X	X	X
Dairy Creek		X									2	3	5	5	5		X	X	
Davies Creek		X								X	2	2	4	5	5	X	X	X	
Deer Creek		X	X	X	X						4	2	5	5	5		X	X	X
Deer Creek-North Fork		X									2	4	5	5	5		X	X	X
Deer Creek-South Fork		X									2	3	4	5	5	X	X	X	X
Diamond Creek		X	X		X				X	X	4	3	4	3	4	X	X	X	X
Ephraim Valley Creek		X		X					X		3	2	5	5	5		X	X	X
Georgetown Creek	X	X	X						X		5	2	5	3	3		X	X	X
Georgetown Creek-Left Fork	X	X	X						X		2	3	5	4	5		X	X	X
Georgetown Creek-Right Fork		X									2	3	5	3	3		X	X	
Goodheart Creek		X	X						X		2	3	5	5	5		X	X	
Gravel Creek		X	X						X		2	3	4	5	5		X	X	
Hornet Creek		X									1	2	5	5	5	X	X	X	
Indian Creek											1	5	5	5	5	X			
Johnson Creek											1	5	5	5	5	X			

[2,3,4,5,6,7] See footnotes at end of table.

Table 1-22.--Selected fisheries and fishery conditions within the study area--Continued

Stream, lake, or reservoir	Fish species present									Contributes cutthroat to Blackfoot system	Fishery rating[2]	Current environmental influences				Condition			
	Rainbow	Cutthroat	Brook	Brown	Whitefish	Sucker	Dace	Shiner	Sculpin			Livestock[3]	Logging[4]	Roads[5]	Mining[6]	Ephemeral stream	Perennial stream	Resident salmonid[7]	Hatchery salmonid
Jones Canyon Creek											1	5	5	5	5	X			
Kendall Creek		X								X	3	4	5	5	4		X	X	
Lanes Creek		X							X	X	4	3	4	5	4		X	X	X
Maybe Creek		X									1	2	5	5	1	X	X	X	
Manning Creek											1	3	4	5	5	X	X		
Meadow Springs											1	5	5	5	5	X			
Mill Creek- Blackfoot Narrows		?								?	1	2	5	5	3		X	X	
Mill Creek- Diamond Creek		X								X	2	3	4	5	4		X	X	
Montpelier Creek	X	X	X	X					X		5	3	5	4	4		X	X	X
Mosquito Creek		X								X	2	3	4	5	5	X	X	X	
Olsen Creek		X	X							X	2	3	4	5	5		X	X	
Palisades Reservoir	X	X		X	X	X					5	4	5	5	5		X	--	X
Pine Canyon Creek											1	5	5	5	5	X			
Preuss Creek		X							X		4	2	5	5	5		X	X	X
Sage Creek		X		X	X	X			X		4	3	5	5	5		X	X	X
Sage Creek- South Fork		X		X					X		3	3	5	5	5	X	X	X	X

[2,3,4,5,6,7] See footnotes at end of table.

Table 1-22.--Selected fisheries and fishery conditions within the study area--Continued

Stream, lake, or reservoir	Fish species present									Contributes cutthroat to Blackfoot system	Fishery rating[2]	Current environmental influences				Condition			
	Rainbow	Cutthroat	Brook	Brown	Whitefish	Sucker	Dace	Shiner	Sculpin			Livestock[3]	Logging[4]	Roads[5]	Mining[6]	Ephemeral stream	Perennial stream	Resident salmonid[7]	Hatchery salmonid
Sheep Creek		X							X		5	3	5	5	4		X	X	X
Smoky Canyon Creek		X									2	3	4	5	4	X	X	X	?
Soda Point Res.	X	X			X	X	X	X			2	4	5	5	3		X	--	X
Stewart Creek		X								X	2	3	5	4	4		X	X	
Slug Creek		X	X			X	X		X	X	4	2	5	5	5		X	X	X
Stump Creek		X									4	3	5	5	5		X	X	X
Sulphur Creek		?									1	3	5	5	4	X	X		
Swan Lake	X										3	5	5	5	5		X		X
Swan Lake Gulch Cr.											1	5	5	5	5	X			
Swan Lake Reservoir						X					1	5	5	5	5				
Timber Creek		X								X	2	3	4	3	4	X	X	X	
Timothy Creek		X								X	2	3	5	5	5	X	X	X	
Trail Creek		X									2	3	4	5	4	X			
Tygee Creek		X		X							2	3	5	5	5		X	X	X
Webster Creek		X									5	3	5	5	5		X	X	X
Wells Canyon Creek		X									1	3	5	5	4	X	X	X	X
White Dugway Creek		X		X					X		3	2	5	5	5		X	X	X
Wood Canyon Creek											1	5	4	5	5	X			
Yellowjacket Creek		X								X	2	2	5	5	4	X	X	X	X
Warm Creek				X							4	3	3	5	5		X	X	X

[2,3,4,5,6,7]Footnotes follow on next page.

Table 1-22.---Footnotes

[2] 1, The stream provides no fishing, and if a fish population does exist there still is no significant value; 2, The aquatic environment produces some fish but stream or fishery conditions do not attract fishing recreationists, or there is opportunity for this stream to contribute a low number of fish to offsite streams; 3, The aquatic environment produces fair fish populations receiving some fishing pressure, or the stream contributes low numbers of fish to offsite streams used by recreationists; 4, The aquatic environment produces good fish populations which are sought after by recreationists, or the stream or lake contributes moderate numbers of fish to offsite streams receiving moderate recreation demand; 5, The aquatic environment produces excellent fish populations which are highly sought by recreationists, or the stream or lake may contribute high numbers of fish to offsite streams receiving high recreation use.

[3] 1, Livestock use has caused severe aquatic damage; 2, Livestock use has caused high stress; 3, Livestock use has caused moderate stress; 4, Livestock use has occurred but stress is absent or insignificant; 5, No livestock use in area.

[4] 1, Logging has caused severe aquatic damage; 2, Logging has caused high stress; 3, Logging has caused moderate stress; 4, Logging has occurred but stress is absent or insignificant; 5, No logging has occurred.

[5] 1, Roads have caused severe aquatic damage; 2, Roads have caused high stress; 3, Roads have caused moderate stress; 4, Roads in drainage but stress is absent or insignificant; 5, No roads occur.

[6] 1, Mining has caused severe aquatic damage; 2, Mining has caused high stress; 3, Mining has caused moderate stress; 4, Mining has occurred but stress is absent or insignificant; 5, No mining in area.

[7] Double dash indicates data not available.

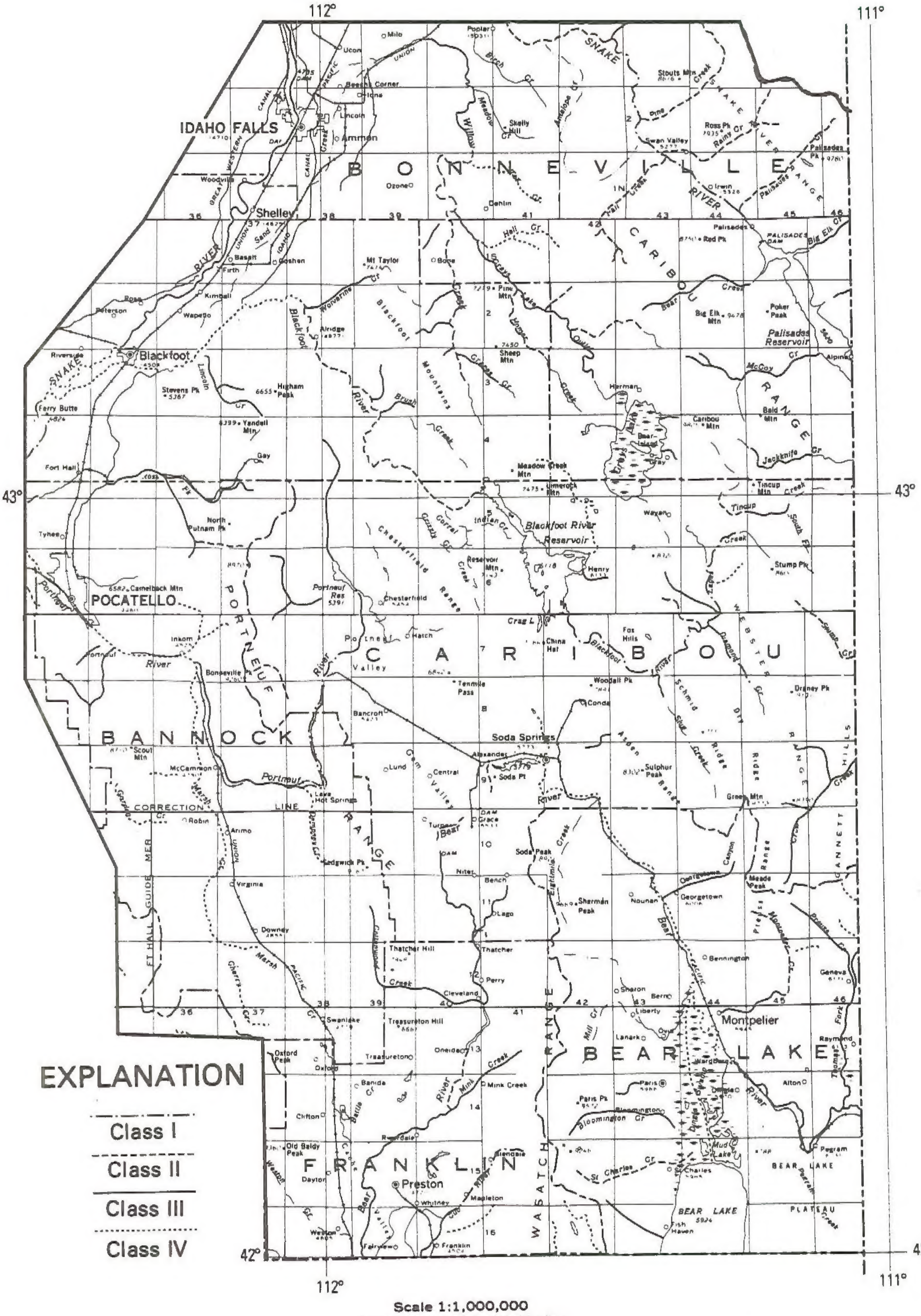

FIGURE 1–22a.—Classification of streams in the study area. From Idaho Fish and Game Department.

have done very well in extending their range and numbers. They adapt readily to the beaver-modified stream environments because of less restrictive spawning requirements. Brook trout have probably had more to do with replacement of cutthroat trout than any other species or factor other than pollution. They have expanded their range to include about 21 percent of the streams.

Species of whitefish, sucker, shiner, sculpin, perch, sunfish, dace, and chub also occur in the study area. Cisco occur only in Bear Lake and are much sought after in December and January as they approach the shore to spawn.

B. CULTURAL ENVIRONMENT

1. LAND USE

a. Land Ownership

The study area is sparsely settled, and the population is largely concentrated in a few areas; Pocatello-Idaho Falls, Soda Springs, and Montpelier. A reasonably adequate transportation network connects the population centers; secondary roads provide access to more remote areas. Much of the area is within the Caribou National Forest. Agriculture, the dominant industry, includes dry and irrigated farming and livestock grazing. An established phosphate mining and processing industry is a significant part of the industrial development. Although still relatively unexplored or identified, the area has significant potential for archeological and historical discovery. It is widely used for outdoor recreation, the most popular activities being hunting and fishing, camping, picnicking, and pleasure driving. Although not spectacular, the area offers aesthetic appeal through the varied topography, remoteness, and seasonal changes in vegetation.

Land ownership and control within the study area is of a complex nature. The lands were originally acquired by the United States through the Oregon Compromise of 1846 from England. Westward movement by way of the Oregon, Lander, and Mormon trails brought settlers to the area. Lands along the Bear River, Snake River and their major tributaries were the first settled, and passed into private ownership.

The Fort Hall Indian Reservation was established in 1868. The Shoshone and Bannock Tribes of the Fort Hall Reservation, through the Treaty of Fort Bridger on July 3, 1868 and ratified by the United States Senate on February 16, 1869, ceded lands to the United States. The study area lies within the ceded area. A follow-up agreement with the Shoshone and Bannock Indians of the Fort Hall Reservation, concluded February 5, 1898, ratified June 6, 1900 (31 Stat. 672) states in Article IV of the Act to ratify the agreement (31 Stat. 674) as follows:

> "So long as any of the lands ceded, granted, and relinquished under this treaty remain part of the public domain, Indians belonging to

> the above-mentioned tribes, and living on the reduced reservation, shall have the right, without any charge therefor, to cut and to pasture their livestock on said public lands, and to hunt thereon and to fish in the streams thereof"

According to the Bureau of Indian Affairs, these treaty rights continue to exist in the study area.

With the admission of Idaho as a State in 1890, surveyed sections 16 and 36 of each township was vested with the State as school endowment lands. Where such sections had passed into private ownership or, prior to survey, these lands had been reserved or withdrawn by the Federal government, the State was granted the right to select inlieu lands as indemnification. In 1907 the Caribou National Forest reserve was established.

Through the late 19th century and early 20th century the public lands were settled and continued to pass into private ownership primarily through the agricultural land laws. The remaining unreserved public lands now comprise the Natural Resource Lands under the management and administrative jurisdiction of the Bureau of Land Management. Due to the variety of land withdrawals, reservations, selection, settlement and disposal actions, a somewhat complex ownership pattern has resulted. This is especially true with respect to the mineral estate, and particularly to the phosphate resource. Ownership of the land and mineral estate now exist in the following combinations.

(1) Private surface ---------Private minerals (all)
(2) Private surface----------Federal minerals (all)
(3) Private surface----------Federal minerals (partial)
(4) Private surface----------State minerals (all)
(5) State surface------------State minerals (all)
(6) State surface------------Federal minerals (all)
(7) State surface------------Federal minerals (partial)
(8) Federal surface----------Federal minerals (all)

Table 1-23 shows the ownership breakdown in the study area by county.

b. Agriculture and Range

Agricultural crop production within the area varies with elevation, climate, soils, water availability, transportation, and certain other factors.

Small grains, (wheat, oats and barley) are grown under physical conditions which vary from irrigated lower river valleys to dry farms at higher elevations. Major wheat-producing areas are the dry land farms on the Antelope Flats at the northern end of the area, and the foothill areas on the west-facing slope of the Blackfoot Mountain foothills in the Bear River Valley from Montpelier northward to the Blackfoot River Reservoir. The major barley-producing areas are at the higher elevations where the growing season is shorter. The major production areas are the east-facing foothill area of the Caribou Range (which is

Table 1-23.--Land uses of private land and ownership of surface rights in study area, by acres and counties[1]

Use or owner	Bear Lake	Bingham	Bonneville	Caribou
LAND USES OF PRIVATE LAND				
Cropland				
Dry	56,000	18,160	195,980	191,890
Irrigated	56,850	94,550	77,500	58,180
Range and pasture				
Dry	193,200	178,210	112,270	299,730
Irrigated	1,200	24,190	--	25,000
Urban	6,600	1,920	11,510	13,100
Water[2]	1,650	960	1,880	560
Forest and woodland	18,630	16,900	9,480	81,740
Other	8,450	10,570	4,500	4,200
Total	342,580	345,460	413,120	664,400
OWNERSHIP OF SURFACE RIGHTS				
Bureau of Land Management	43,465	26,732	13,240	70,393
Forest Service	229,335	0	480,055	304,036
National Wildlife Refuges	17,600	0	17,650	0
State	18,842	53,425	51,515	104,084
Private	323,078	265,950	397,259	429,506
Total	632,320	351,107	959,719	908,019

[1] Private land data from Soil Conservation Service. Acreage in Bingham and Bonneville Counties for areas south of Snake River only.

[2] Not including lakes.

also the western border of Star Valley, Wyoming), the rolling plains and foothill areas extending northward from the Blackfoot River Reservoir, and those areas fringing the reservoir to the south and west. Oat production is limited. This grain is often used as a cover crop in establishing new alfalfa seedings on irrigated farm lands. When harvested, it is used as a protein concentrate for pleasure horses and young cattle. All three small grain species in the irrigated farms are used in rotation practices with row crops (sugar beets, potatoes, and corn) and alfalfa. Alfalfa hay is grown in all the irrigated valleys. To a limited amount, drought resistant varieties are grown on dry farms.

Meadow hay is produced in the marshlands along the Bear River and along the river bottoms of the Salt River. Inland mountain valleys, such as Dry Valley, Upper Valley, Wooley Valley, Crow Creek and Grey's Lake, also produce meadow hay.

The following table lists acreage of selected crops in the study area for 1974:

	Bear Lake	Bingham	Bonneville	Caribou	TOTAL
Spring Wheat					
Irrigated	1,100	15,510*	18,525*	2,000	37,135
Dry Land	14,300	1,100	5,025	7,300	27,725
Winter Wheat					
Irrigated	200	11,940*	15,900*	700	28,740
Dry Land	4,100	11,200	44,600	30,000	89,900
Barley					
Irrigated	4,000	7,320*	12,600*	23,000	46,920
Dry Land	9,300	1,600	26,400	57,400	94,700
Potatoes (1973)	0	16,140*	29,850*	5,500	51,490

*Approximately 75% of the irrigated land in Bonneville County and 30% of the irrigated land in Bingham County lies south of the Snake River. These figures represent only that portion of these counties in the study area.

Source: 1975 Idaho Agricultural Statistics

Historically, the livestock industry has been closely tied to and is an integral part of the economic conditions of the study area. Early settlers were dependent on the range lands at higher elevations for summer grazing for sheep, cattle, and horses. The area was also used intensively by the large migratory cattle and sheep herds before the turn of the century. With the permanent settlement of the area, the grazing operations became smaller, more numerous, and directly associated with smaller farming operations.

During recent years, the smaller operations have been acquired by the larger ranchers. The result now is a few large operations in the inland part of the study area, with the small operations dependent on and attached to the small family farms on the periphery of the National Forest. The total number of cattle and calves in counties of the study area, by selected years, are given in the following table:

County	1954	1959	1964	1969
Bear Lake	30,364	32,621	30,746	30,180
Bingham[1]	27,407	29,956	38,852	48,463
Bonneville[1]	30,879	30,139	38,011	41,217
Caribou	30,602	30,809	33,121	32,521

[1] About 75 percent of Bonneville County and 45 percent of Bingham County is south of the Snake River; data shown are these percentages of totals for these counties. Source: 1974 Idaho Agricultural Statistics

In 1973, the Caribou National Forest within the study area provided 182,567 sheep months of grazing for 102,986 head of sheep. It also provided 43,591 cow months of grazing for 12,456 head of cattle and 463 horse months of grazing for 182 head of horses. Three hundred and sixty livestock operations have grazing privileges on these National Forest lands.

Cattle-grazing permittees typically have farms and ranches adjacent to or within a few miles of the National Forest boundary. The National Forest lands provide summer and fall grazing for their herds. The cattle are either fed harvested forages or grazed on off-forest pastures during the remainder of the year. Sheep-grazing permittees usually do not have home ranches near the National Forest lands. Many sheep permittees are based in the Snake River Valley near Burley and American Falls. National Forest lands provide summer ranges for these flocks. Spring, fall and winter ranges are on either National Resource, State, or private lands, or a combination of all three.

Present livestock stocking levels on National Forest lands are but a fraction of the numbers permitted in earlier years. Reductions in permitted livestock numbers were initiated following the establishment of the Forest Reserves. Reductions were made to bring livestock numbers in line with forage production and to eliminate conflict with other resources. Further adjustments in livestock grazing as a result of other changes in land use may be expected in the future.

Cattle are generally driven to the forest ranges from the nearby ranches. Some sheep bands are hauled by truck to locations on or near the National Forest. Other bands are herded onto Forest land. These bands may leave their home ranch in early spring and be on the trail for three months or more. The herded band's route of travel is dependent upon where the operator has grazing privileges. Designated sheep driveways are used on the National Forest to move bands to and from various grazing allotments.

Grazing on the National Resource Lands is authorized under one to ten year grazing leases based on contiguous privately owned land. Presently, there are 316 lessees using 140,400 acres of National Resource Lands within the study area. Cattle and sheep harvest 17,500 AUM's of feed. The grazing season on BLM lands is from May through October. On National Forest lands, it is normally about a four-month period ranging from late May to early October. Livestock grazing is supplemental to other farming activities.

Chronic fluorosis in farm animals has been reported in areas adjacent to industrial plants emitting fluorine-containing gases and dust. Fluorine is liberated during acidulation and electric-furnace reduction of phosphate rock; the amount currently being produced from phosphate rock is not known. Livestock ingest the fluorine by grazing forages and consuming hay on which these gases and dusts have settled.

In the early 1950's, some livestock operators in the vicinity of the processing plants claimed that their livestock were being affected. A few settlements were made before the Department of Chemistry at the University of Idaho began investigative studies. These studies began in the Pocatello area in 1956 and have continued to the present in the Pocatello and Soda Springs areas. When the Georgetown Canyon plant closed in 1963-64, the studies there ceased. Detailed data on fluorine emissions are given in the section on air resources.

During a review of the current fluorine situation, some companies helpfully provided information concerning livestock losses for which compensation had been paid and operators affected by the alleged losses to fluorosis, while other companies were reluctant to discuss the subject. Still, investigation of cattle herds near the processing plants has revealed that competent veterinarians and animal-nutrition researchers from Utah State University and the University of Idaho did establish that productivity and life expectancy of animals were affected. Settlements have been made for at least 2,000 animals. In most cases, they were made out of court at a value determined by veterinarians. On occasion, whole herds were bought at current market value. The difference between market value and replacement cost for breeding animals has been paid by companies in some instances. In other instances, land in the vicinity was purchased by companies, not necessarily because of fluorosis but also for other reasons. Cases were also reported of companies purchasing hay crops and replacing them with hay from outside the affected areas.

The impact of fluorosis on livestock production has not been quantitatively measured to date. Therefore, the above settlements may have been greater or less than the losses that have occurred as a result of fluorosis. Livestock operators in the area who have not received settlements may have been adversely affected but it is not known to what degree.

In order to live with or overcome the fluorine problem by limiting fluorine intake, some livestock operators have modified their operations, using several approaches with some apparent success. Some have purchased grazing lands outside the affected area to keep lactating cows and calves away from the affected area during the development stages of the young replacement females. In some cases, affected pasture is grazed by steers and nonreplacement females, but they are fed hay from an unaffected area. In other cases, both hay and grazing lands have been purchased outside the affected areas, and the affected areas are not grazed. Also, all cattle have been sold, and affected pasture has been leased to operators who winter in some other area with hay not produced in the affected area.

For existing cattle operations to function successfully, it has become necessary in many instances to reseed, eradicate brush, and construct both fences and watering facilities. Fires have been rare in the area and have not changed forage species or the established grazing operation.

c. Mineral Industry

1. Phosphate Mining

Four mining operations on Federal phosphate leased land and one operation on the Fort Hall Indian Reservation currently produce phosphate rock in southeastern Idaho. The combined 1975 production from Federal lease operations on Monsanto's Henry mine, Beker Industries, Maybe Canyon mine, Simplot's Conda mine and Stauffer's Wooley Valley mine was about 4.5 million short tons of this, about 750 thousand of mine-run rock was shipped out of Idaho for processing. A portion went to an elemental-phosphorus plant in Montana, and the rest was concentrated at a beneficiation plant in Wyoming.

The remainder of the 1975 Federal lease production--3.8 million tons--was processed locally with about 1.0 million tons going to the Monsanto elemental plant near Soda Springs, 2.3 million tons to the Beker, fertilizer plant at Conda and 500 thousand tons going to the Simplot fertilizer plant at Pocatello.

The Gay mine, operated by J. R. Simplot Co., produced about 2.5 million tons from Indian land. About 2.0 million tons went to FMC's elemental plant and 500 thousand tons went to Simplot's fertilizer plant, both located in Pocatello.

At each of these mines, the phosphate rock is exploited by open-pit mining methods along the outcrop of the phosphoria Formation. The first important phosphate mining in this area came from selective underground mining of this same formation (See Part 1, Ch. I). The advent of large-scale earth-moving equipment, improved beneficiation methods, and favorable stripping ratios for mining outcrops contributed to development of large tonnage openpit mining methods. Unlike underground mining, where selected ore beds are mined with a minimum of waste rock, open-pit mining frequently involves excavating several cubic yards of waste for each ton of ore recovered.

Mineralization within the Phosphoria Formation varys significantly in phosphate content and percentages of associated elements. Excessive amounts of calcium oxide, iron oxide, silica, and organic material are detrimental to the refining process. Recognizing this need for uniform and uncontaminated processing-plant feed mine operators have developed the ability to selectively mine and blend large tonnages of varying grade phosphate rock.

The mining methods of the operations on the four Federal leases are similar. Following is a general description of the methods.

In phase 1 top soil, where it occurs in significant amounts, is excavated and stockpiled for revegetation of disturbed land. Marketable timber is harvested and non-utility vegetation is control burned, buried, or utilized as brush barriers to control erosion.

In phase 2, overburden and interbedded waste shales are removed and placed in waste dumps on sites selected for proper drainage, favorable haul distance from the pit, and out of the way of future mining operation. Excavation of hard, blocky wall rock frequently requires drilling and blasting.

In phase 3, the mineralized zones are selectively mined and transported to blending piles at the mine loadout facilities or at the processing plants. Combinations of power shovels and trucks, front-end loaders and trucks, and dozer-assisted scrapers are used for mining and waste-rock removal.

Weather conditions in southeastern Idaho dictate that ore be mined, transported, and stockpiled at processing plants during the summer period of May through October. Winter rock handling in railcars or trucks is unsatisfactory due to freezing. Winter mining increases ore moisture content, and drifting snow and slick roadways increase safety hazards.

Providing winter-long ore stockpiles requires a closely-planned mining schedule. Figure 1-23 shows a commonly-used sequence of overburden, waste shale, and ore removal. The figure shows a typical hanging wall and footwall ore occurrence separate by waste shales. The numbers indicate the overburden removal sequence, and the letters indicate ore mining.

Pit depth is determined by the continuity of mineralization -- and the stripping ratio. This ratio provides the measure of how many units of waste rock are removed for each unit of ore mined. Knowing the unit cost of stripping waste and mining ore and the unit value of the ore, the economic mining depth can be calculated. The eventual pit depth is also governed by wall-rock stability, ground-water conditions, and chemistry of the ore; with current mining costs and ore prices, stripping ratios of 3:1 are common. This is an increase from 2.6:1 prevailing a short while ago.

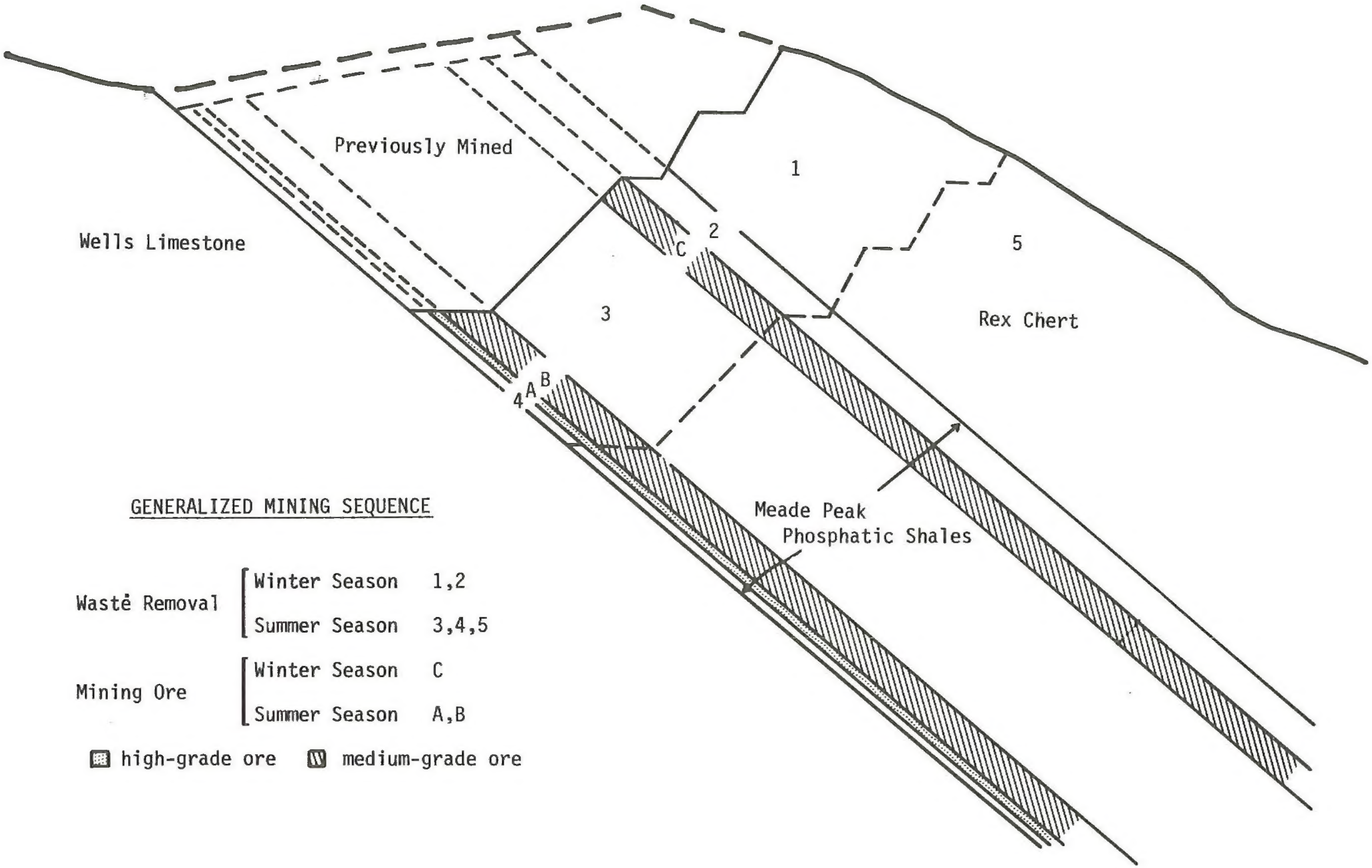

Figure 1-23.--Typical cross section of open-pit mine.

Constructing the waste rock dumps includes placing coarse rock in the interior and mantling the dump exterior with waste shales on top soil. When waste rock is moved by dump truck, the waste pile is usually built up from several levels by dumping the rock over the edge and permitting the material to find its natural angle of repose. These are free-fall dumps. Other companies construct the waste dump by using self-dump scrapers to place the rock in layers from the bottom up. It is claimed that better compaction of rock is attained. This method is adapted where relatively low lying, contoured dumps are desired.

Many of the largest dumps are of the free-fall types with the rock placed at the angle of repose and having long unbenched slopes. These unvegetated slopes tend to erode with numerous cuts and gullies. The dumps that are terraced with sloped benches, which direct surface water to natural soils on the edges of the dump, are subject to less erosion. Catchment basins are constructed below the dump to collect water and sediment.

Waste disposal is primarily a winter operation and care is taken not to bury snow within the dump. Thawing of the buried snow has caused subsidence and rock flow. Where backfilling of pits with waste rock is not practiced, waste dumps frequently cover areas from two to four times the pit area. Five phosphate mines are ongoing operations in which developing mine programs are continuations of current operations. Their mining methods generally conform to the previous discussion of mining methods.

The Gay mine is on the Fort Hall Indian Reservation about 50 miles northwest of Soda Springs. Mining has been continuous since its beginning in 1946. It is operated by J. R. Simplot Company to provide phosphate rock for its fertilizer complex at Pocatello and for the FMC elemental plant, also at Pocatello. Past production has amounted to about 2 million tons annually. The production for 1975 was about 2.5 million tons with 2 million tons going to FMC and 0.5 million tons to Simplot.

The Conda mine (figure 1-24) is located 6 miles northeast of Soda Springs, Caribou County, Idaho. The most significant acreage of the Simplot holdings at Conda is the approximately 13 miles of phosphate outcrop occurring on patented mining claims which are not under the jurisdiction of the Federal Government. The Federal phosphate leases cover land adjacent to and between the patented land. Ore is mined at a rate of 900,000 tons annually. The 1975 production was about 1 million tons. The ore, upgraded in a beneficiation mill at Conda, is blended to 31 to 32 percent P_2O_5 and shipped by rail to Simplot's acid fertilizer complex at Pocatello.

The Henry mine (figure 1-25) is located 14 miles northeast of Soda Springs. At this property, 5 miles of phosphate outcrop is in various stages of development and mining. Annual production is approximately 1 million tons. The entire mine output is shipped by haul truck and trailers on a private haul road to the Monsanto elemental phosphorus plant north of Soda Springs.

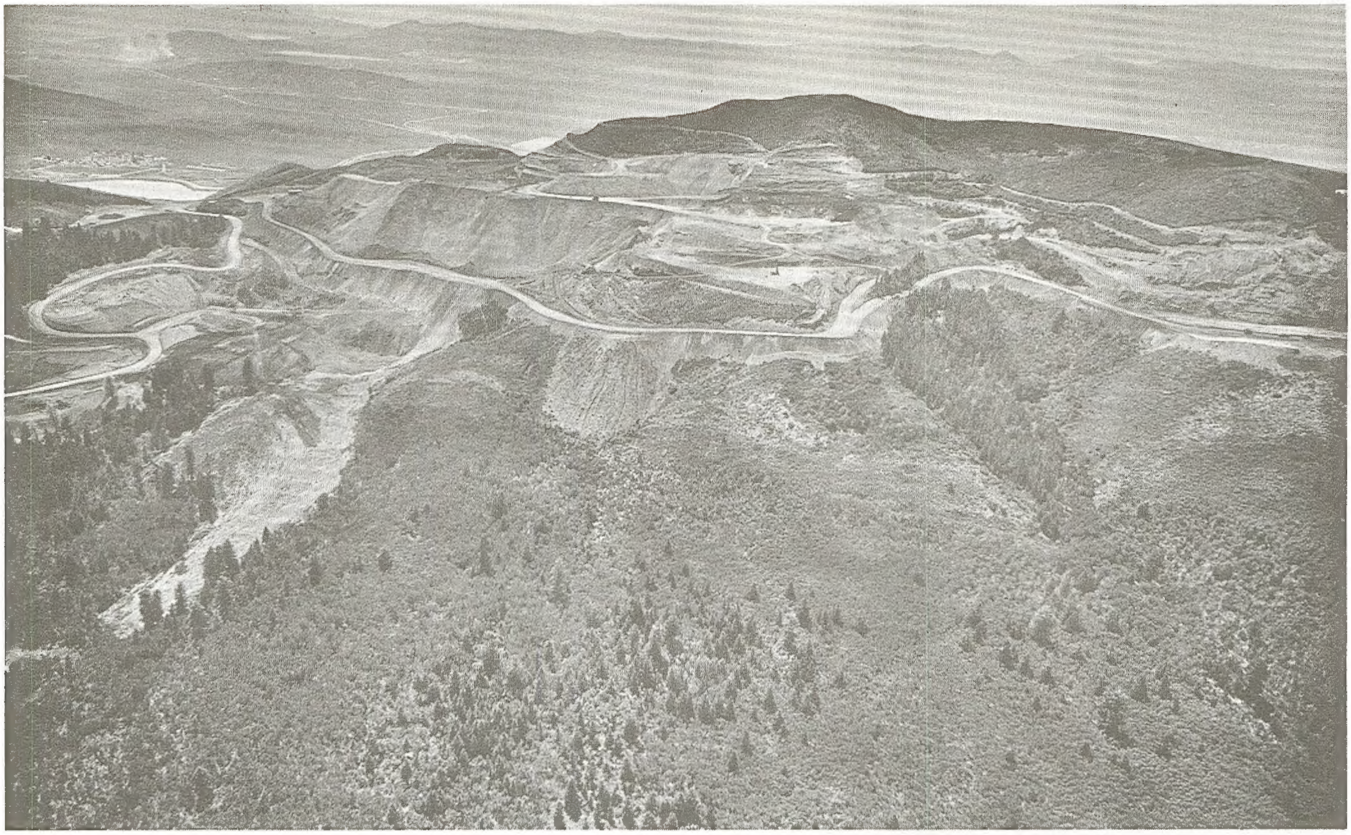

Figure 1-24.--Aerial view of Conda mine.

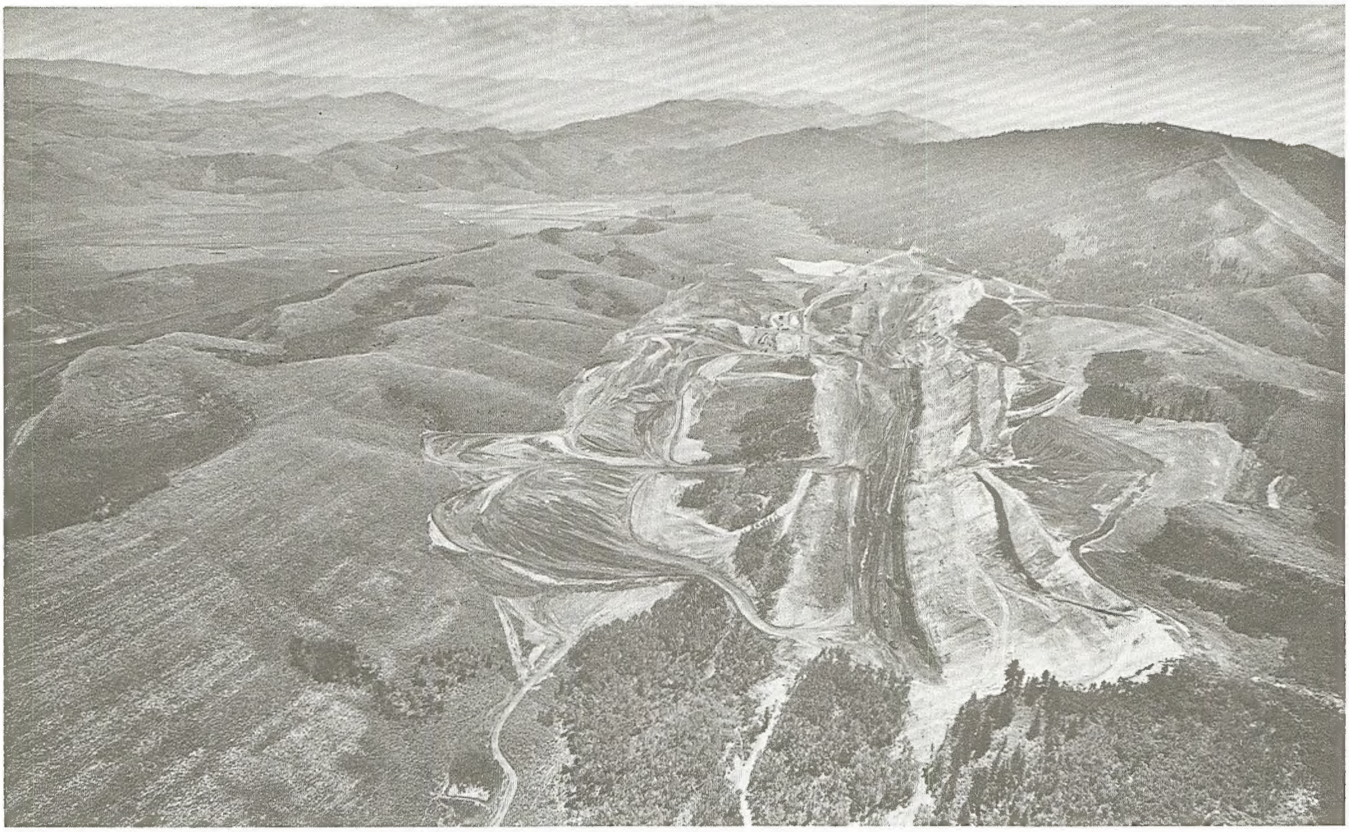

Figure 1-25.--Aerial view of Henry mine.

The Wooley Valley mine, (figure 1-26) located mainly within the Caribou National Forest, lies 15 miles northeast of Soda Springs. The property covers more than 5 miles of phosphate outcrop. Production of in 1975 was about 750 thousand tons. The rock is shipped from a terminal near the mine via unit train to Stauffer's elemental-phosphorus plant at Silver Bow, Montana. A portion of recent production was processed at a Wyoming acid fertilizer plant.

Maybe Canyon mine (figure 1-27) is situated 16 miles northeast of Soda Springs, is entirely within the Caribou National Forest. About 5 miles of phosphate outcrop are involved with this mine. Phosphate rock production in 1975 was about 2.3 million tons. The ore is transported about 19 miles via rail to the Beker Industries beneficiation plant at Conda. Here, it is processed into fertilizer.

a. Reclamation

The reclaiming of mined lands, particularly those disturbed by surface mining, has become one of the major considerations in mineral resource development and environmental protection. To this time, there are no Federal statutes specifically requiring the reclamation, rehabilitation, or revegetation of mined lands. However, operating regulations of the Department of the Interior, 43 CFR Part 23, provide for surface protection and reclamation of Federal lands mined by surface methods under the mineral leasing acts.

The Idaho Surface Mining Act (Title 47, Chapter 15, Idaho Code), enacted in 1971, and administered by the Idaho Department of Lands, provides for reclamation of all lands within the State of Idaho disturbed by exploration and surface-mining operations, and it aids in the protection of natural resources. The act requires that a notice of intent to conduct exploration operations be filed along with reclamation and mining plans and a performance bond not exceeding $500 per acre for disturbed lands. An approved reclamation plan is required prior to initiating mining operations.

Restoration and revegetation of mine dumps has been a continuing effort on federally-leased phosphate lands in Idaho. Efforts were seriously initiated in the mid-1960's when four companies, FMC Corporation, Monsanto Company, El Paso Products Company, and J. R. Simplot Company, entered into a cooperative study with the Forest Service to determine how best to rehabilitate surface-mined areas. The primary purposes of rehabilitation, as outlined in the study, were (1) soil stabilization, (2) protection of water quality, (3) return of land to productive use, and (4) restore aesthetics. The study agreement expired in 1970, but efforts have continued over the years by the companies and the administering Federal agencies.

There are within the study areas phosphate mines and waste dumps with varying degrees of reclamation.

The Waterloo mine, (figure 1-28) located about 3 miles east of Montpelier, Idaho is the oldest phosphate mine in the State. The mine

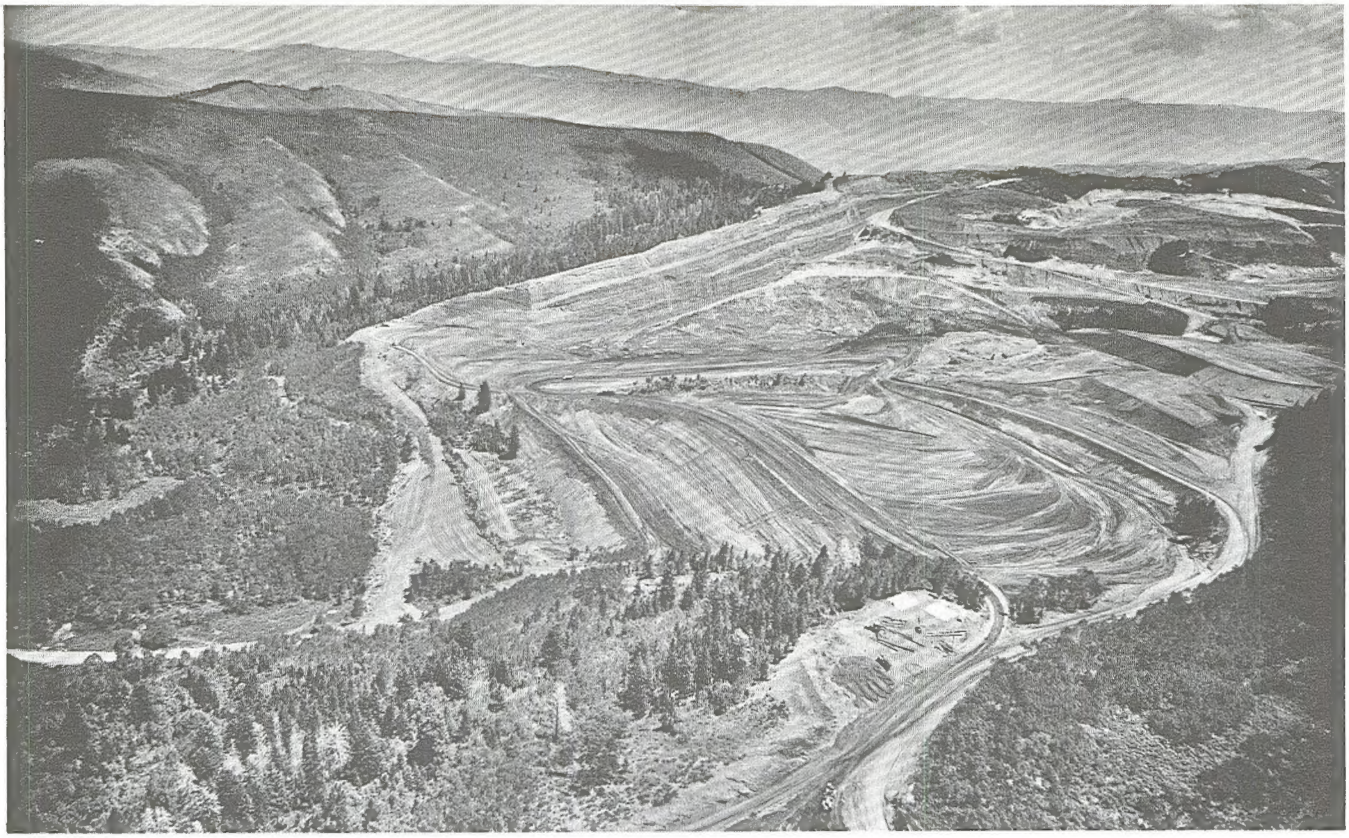

Figure 1-26.--Aerial view of Wooley Valley mine.

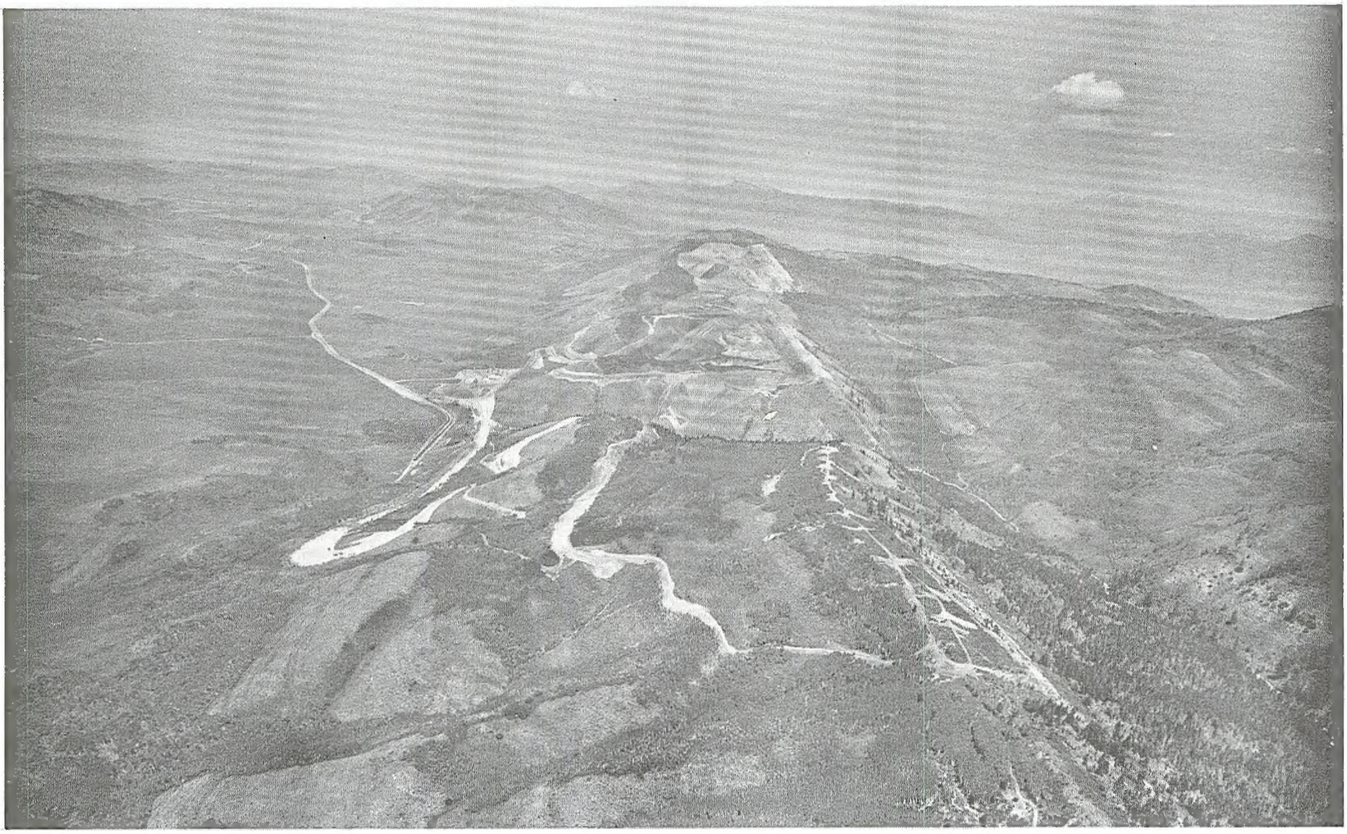

Figure 1-27.--Aerial view of Maybe Canyon mine.

was owned and operated by San Francisco Chemical Company as an underground mine from 1907 to 1929, then as a surface mine periodically between 1945 and 1960. The mine produced about 1¼ million tons of phosphate rock. About 212 acres of land were disturbed near the mouth of Montpelier Canyon. The mine dumps were not stabilized or revegetated. The dump faces have remained steep and devoid of vegetation. As the dumps are composed of very dark rock which absorbs large amounts of solar heat, the establishment of plant growth has been inhibited. The toe of the dump has nearly reached Montpelier Creek, and sediments from the dump have washed into the creek. The mine and dumps are in view of U.S. Highway 89, a major travel route through Montpelier Canyon.

The 400 acres of patented mining claims comprising the Waterloo mine were donated to the Idaho Fish and Game Department by Stauffer Chemical Company in 1970 and 1971, with the provision that the City of Montpelier and Bear Lake County would have the right to use 40 acres of the property for sanitary landfill purposes. The city and county are now using the 40 acres for solid-waste disposal. The Idaho Fish and Game Department plans to restore the mined area for wildlife habitat, particularly deer winter range.

The Georgetown Canyon mine (figure 1-29) is about 7 miles north of Georgetown on the east slope of Georgetown Canyon. The property, consisting entirely of patented mining claims, is presently owned by Beker Industries, Inc. About 2 million tons of phosphate rock were produced from this mine between 1958 and 1961 by Central Farmers Fertilizer Company. About 7,500 feet of surface outcrop was mined to the depth of 125 to 150 feet. Subsequent to mining, the property was sold to El Paso Products Company and then to Agricultural Products Company, a subsidiary of Beker Industries, Inc.

At the time of production, little or no effort was made to stabilize the waste dumps or to revegetate or rehabilitate the disturbed areas. The waste dumps were gravity-flow type, with the dump slopes at natural angle of repose of the loose waste rock. In the mid-1960's, several sedimentation basins were installed below the dumps.

Erosion and sedimentation that resulted from the Georgetown Canyon mine caused severe degradation of the appearance of the creek in Georgetown Canyon and of the condition of the aquatic habitat. Under the Watershed Protection and Flood Prevention Act of 1954 (PL-566), the Forest Service cooperated with the Soil Conservation Service and local organizations to retard the sediment production and improve the aquatic habitats in the creek in Georgetown Canyon. The Forest Service expenditures for this project between 1970 and September 1975 were more than $92,000; expenditures by the SCS and local organizations amounted to $2,500 for the same time period. During this time, the creek in Georgetown Canyon has regained its status as an important fishery in the area and new irrigation projects have been established to use the relatively silt-free waters.

First mining of phosphate on Caribou National Forest lands was at the Diamond Gulch mine owned by San Francisco Chemical Company on

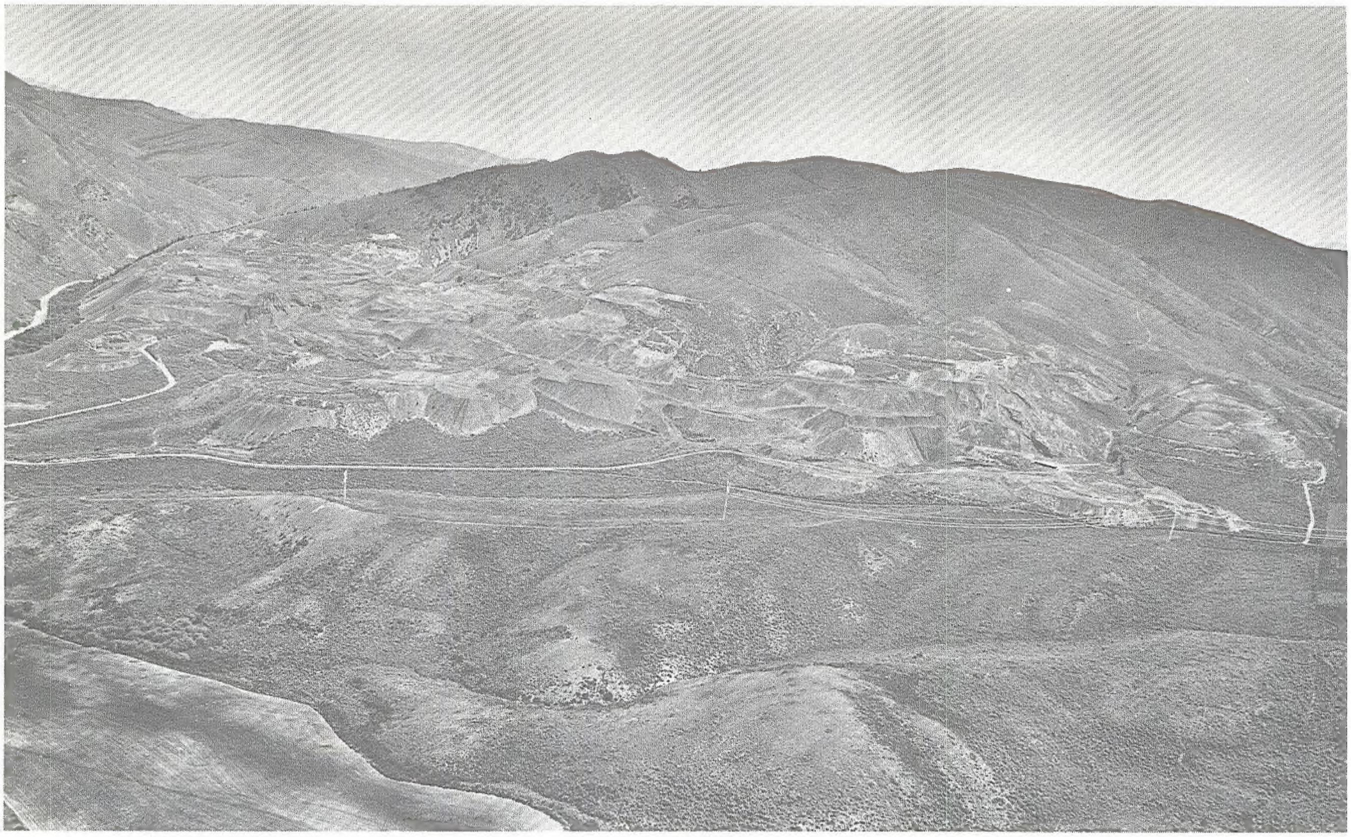

Figure 1-28.--Aerial view of Waterloo mine.

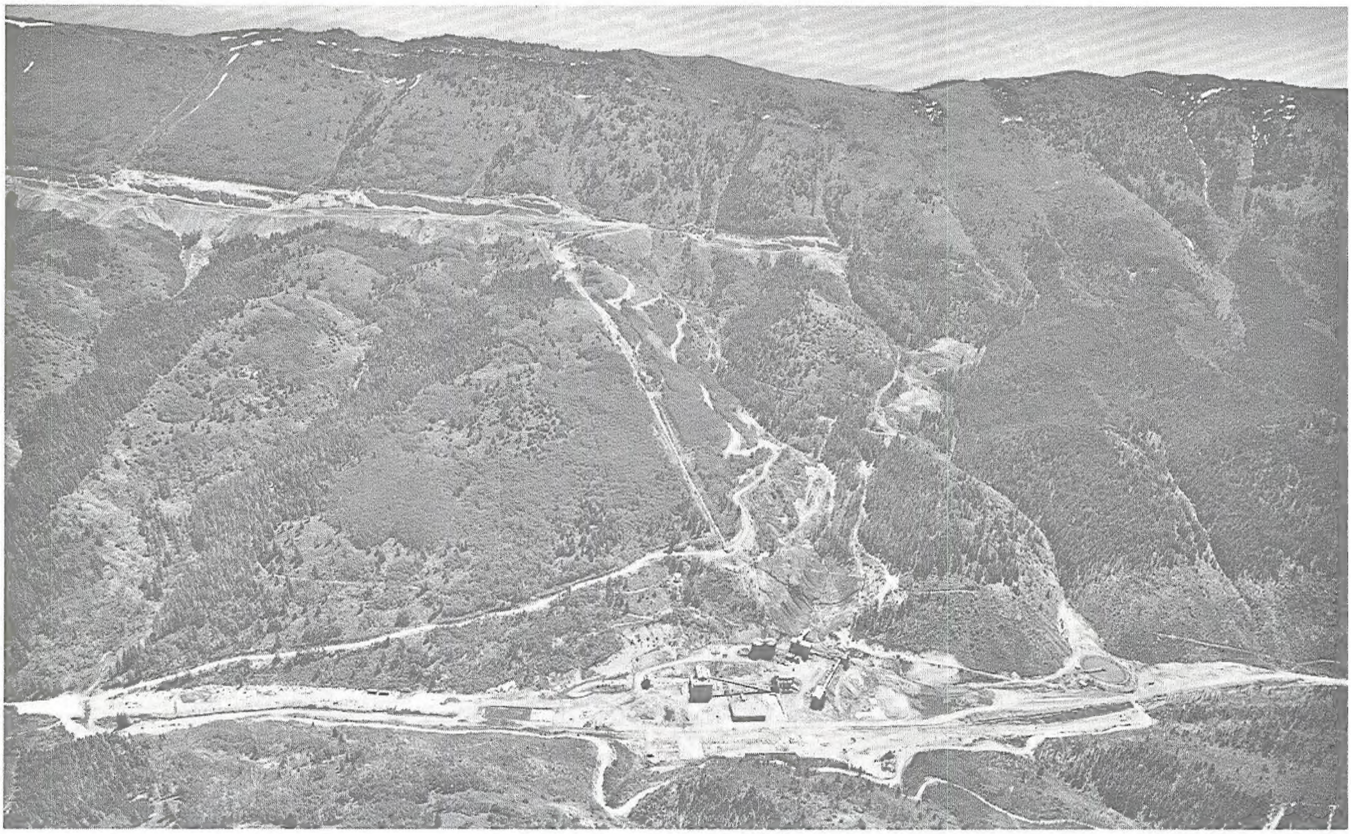

Figure 1-29.--Aerial view of inactive elemental phosphorus plant in Georgetown Canyon.

Federal phosphate lease Idaho 07881. This mine operated in 1960 and 1961 with only about 100,000 tons of phosphate ore produced. Approximately 70 acres were disturbed by the mine pit and waste dumps. Efforts to stabilize by terracing and other measures were unsuccessful. The unsuccessful reclamation efforts pointed up the need for developing techniques for stabilization and rehabilitation of disturbed areas and for a clear understanding of the rights and responsibilities of the lessee prior to commencement of operations. This lease is now owned by Stauffer Chemical Company. In the early 1960's, the Forest Service seeded the disturbed area with a mixture of native grass seed. A fair grass cover has developed, and the area is judged to be in a stable condition.

During 18 years of production, about 11 million tons of phosphate rock was mined and removed from about 191 acres at the Ballard mine (figure 1-30) on Federal phosphate leases Blackfoot 055875 and Idaho 05723. Over 20 million cubic yards of waste rock were stripped during the life of the operation. Of this, 2 million cubic yards were used to backfill the pits; the remaining 18 million cubic yards were hauled to dumps. About 317 acres of land were covered by the waste dumps, and an additional 96 acres were used as service areas. In 1965, the Ballard mine dumps were selected for experimental planting under a cooperative study. A total of 78 different types of tree, shrub, grass, and forb seeds, seedlings, and cuttings were planted on the dumps. To this time, 352 of the 413 acres have been reclaimed.

The mine dumps from Anaconda Mining Company's underground operations at the Conda mine were originally free-flow dumps at or near the main haulage portals east of Conda. These dumps have now been leveled, covered with topsoil, and reseeded. Open-pit operations on the west limb of the Conda anticline were started by the Anaconda Company in 1952. The J. R. Simplot Company acquired mining rights to the Conda properties in 1959, and the open-pit operations in the Woodall Mountain section of the Conda mine were begun in 1961. Because of the adverse topography, the siting and designing of the dumps has presented challenging problems. Presently, about 133 acres are in waste dumps; about 8 acres have been revegetated. Since the late 1960's, dump rehabilitation and revegetation has been preplanned as part of the mining operations. As they are completed, they are reclaimed on a basis of one acre for each acre disturbed each year. These efforts have been directed toward rehabilitating previously disturbed areas.

Recent test rehabilitation and reclamation efforts at the Conda mine illustrate clearly the value of topsoil in promoting revegetation of dumps. A rollover dump at the Conda mine was seeded with brome grass and alfalfa in 1973 on two plots, one with a surface of mine-waste material and the other with a surface of 6 to 8 inches of topsoil. The comparison of growth in 1975 is shown in figure 1-31. The topsoil area after two years has a vegetative cover as dense as that of areas planted in 1969 with mine-waste material at the surface. It should be noted, however, that these test efforts are at the lower elevations of

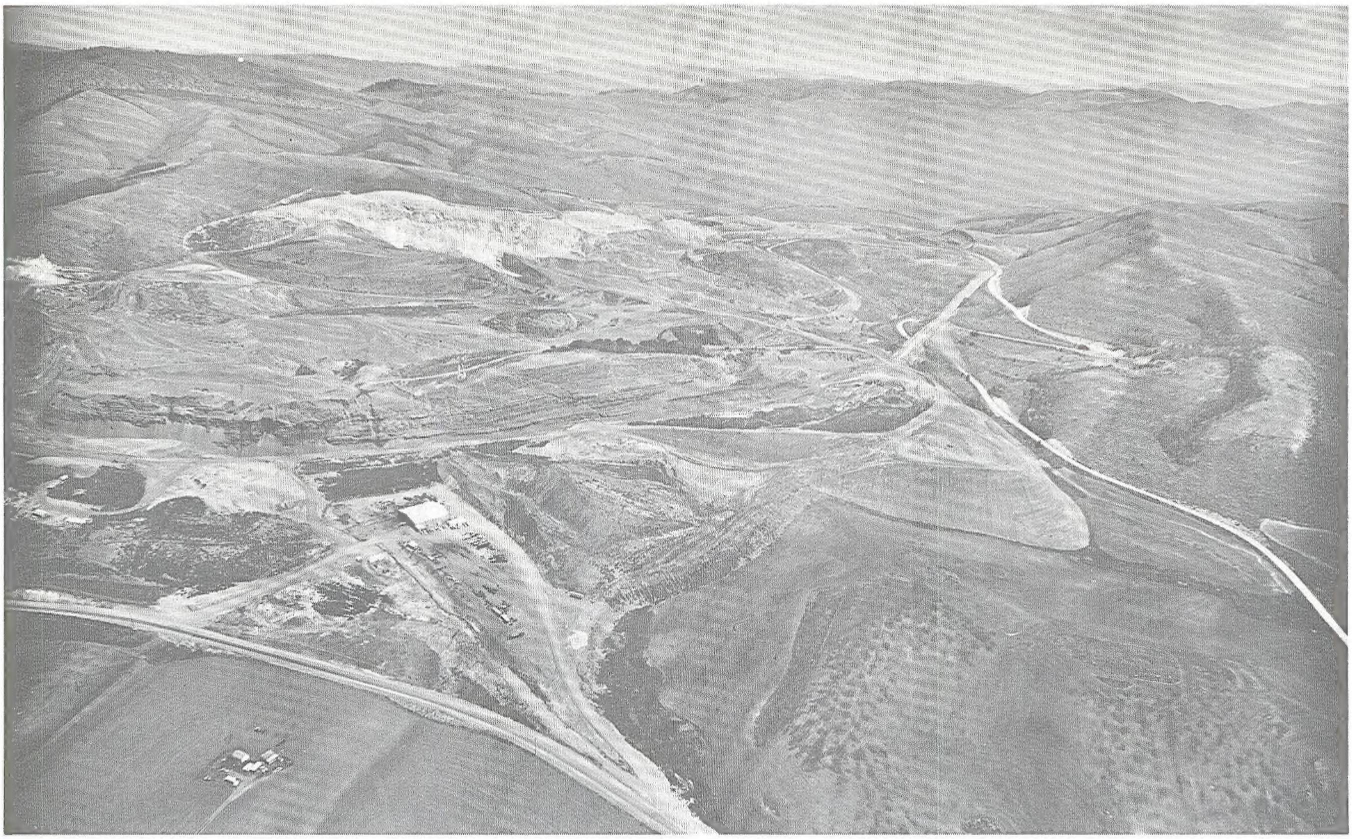

Figure 1-30.--Aerial view of Ballard mine.

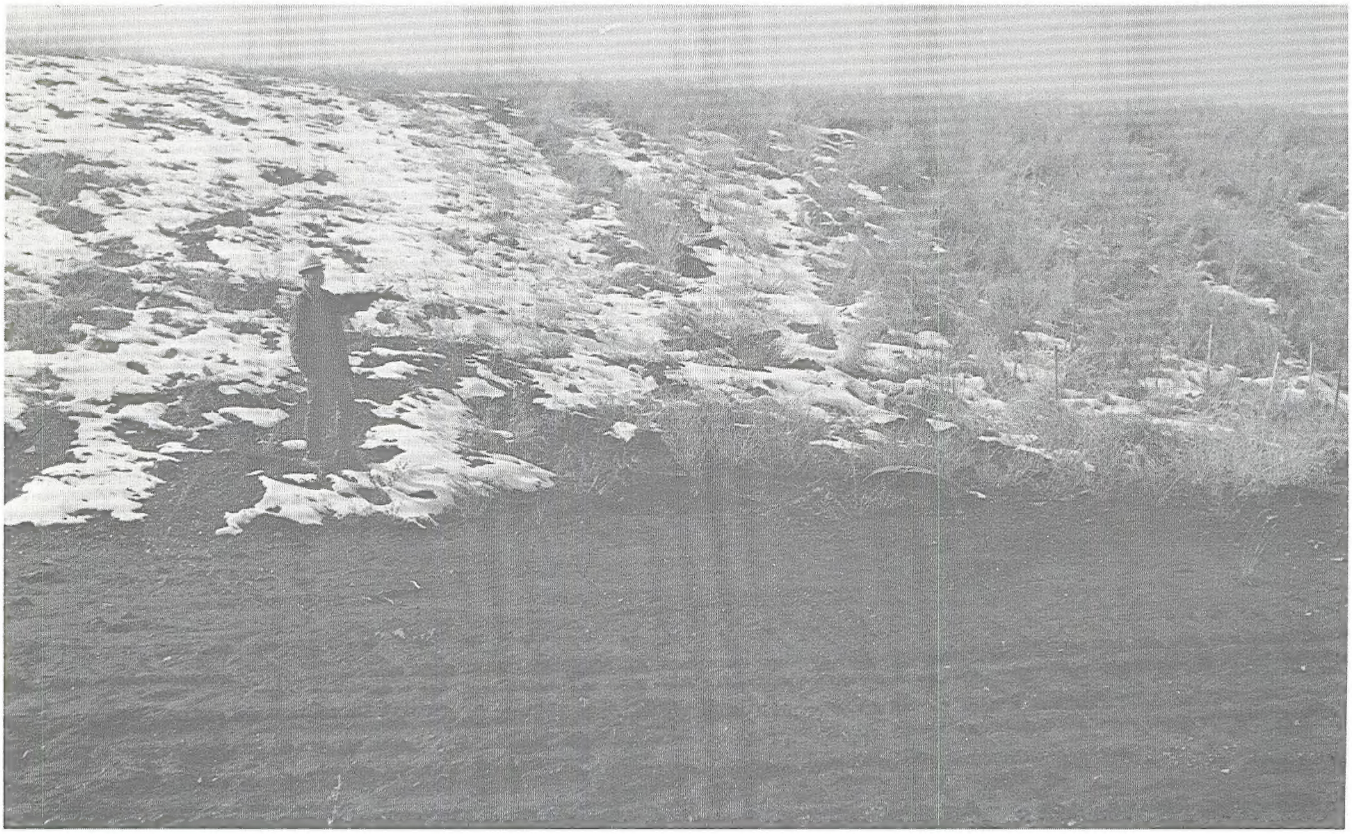

Figure 1-31.--Experimental reclamation plots at Conda mine. Area at left was not dressed with topsoil; area at right was dressed with topsoil.

the Conda mine where growing seasons are longer, and that similar revegetation and stabilization success may not be achievable at the higher, harsher elevations where most mining now occurs.

A cooperative rehabilitation program between the Forest Service and the El Paso Products Company was initiated at the Maybe Canyon mine in 1965. The property ownership passed to Agricultural Products Company and is now held by Beker Industries. The rehabilitation program has not been affected by change of ownership. The primary objective of the program was to protect the quality of the water emanating from the disturbed areas. A secondary objective was to return the disturbed lands to the useful purpose of producing forage, recreation, and wildlife habitat.

Original plans called for the waste to be laid down in near-horizontal lifts. Lifts of 50, 75, and 100 feet were to be tried, each in a separate area, to determine the one most conducive to stability and revegetation. Each lift of waste was to set back 25 feet from the periphery of the previous lift, thus leaving a 25-foot wide bench. Each bench was sloped to the inside, with a shoulder 2 feet higher than the inner edge. Each bench also sloped gently from the middle toward the end of the dump to drain water onto undisturbed ground. Earthen baffles were to be placed at intervals along the length of each bench to hinder the flow and thus reduce erosion and enhance percolation. The baffles also permitted overflow in the lengthwise direction of the bench. The face of the dumps between the benches was to slope at 1.5:1 maximum. The top surface of the dumps sloped at less than 3 percent, with drainage toward the pit or toward original ground. Dumps were sowed with a mixture of grass seed and forbs, and shrubs were planted as each section of dump was completed and as weather and season permitted.

Several weaknesses in the technique became evident: (1) face slopes of 1.5:1 proved too steep, (2) a vertical interval between benches in excess of 50 feet allowed channel erosion of the face, (3) baffles on the horizontal benches retained water, allowing it to saturate the fill and thus weakening the bench to the point of failure. The 3-percent slope on upper surfaces of the dumps was steep enough to cause erosion by runoff waters.

Corrective measures suggested by these weaknesses are being incorporated in specifications for current operations in a continuing effort to obtain viable solutions to these problems.

Stripping of overburden at the Wooley Valley mine began in 1969. Two planned dumps were approved for rehabilitation study. The primary objective was to protect the quality of water emanating from the mined areas; the secondary objective was to restore the disturbed areas to useful purposes of providing forage, recreation, and wildlife habitat. One planned dump had a side slope of 1.5:1, with a slope left rough with a mixture of coarse and fine materials as a seedbed. The top of the dump was concave and sloped toward the original ground. The other planned dump was essentially the same as the above except that the top was allowed to drain toward the sloped dump face. These 2 dumps were successfully sown with grasses in 1970 and 1971. Side slope failures occurred on the dump with the outsloping top due to runoff from the surface. One of the waste dumps at this mine, which had not been approved, suffered massive failure during the winter of 1971 and 1972. Much of the material from this dump was later moved into a depleted portion of the mine pit. To date, about 230 acres have been disturbed, of which about 80 acres can be considered stable. Since this is an ongoing operation, further stabilization and rehabilitation is expected.

The Henry mine was opened in 1969 by the Monsanto Company. Overburden dumps for the mine are located in the valley to the southeast of the outcrop. The dumps are low and broad with terraced faces. The top of the dumps slope gently back away from the face and are undulated so the water will be dispersed in various directions and be absorbed within the dump. The face of the dump is benched with bench heights not exceeding 50 feet. Bench widths are 30 feet and the slopes are designed at less than the angle of repose, usually between 15 to 25 degrees. As dump areas become inactive, they are planted with vegetative species most suitable for survival, erosion control and cover forage for game or livestock.

A total of 221 acres of land has been covered by waste dumps. Of this, 105 acres has been reseeded, with the remainder and all future dumps to be reseeded in the ensuing years as they become dormant. In addition, the waste shales and mudstones are being placed on the highwall benches and reseeded.

Active research is continuing by both industry and governmental agencies to improve reclamation techniques.

Reclamation of mined areas has been under study for years to develop better and more efficient methods of reclamation. These studies have been both joint efforts between the Forest Service and the mining companies and individual efforts of the mining companies themselves. Of these, three studies, two of which have been completed and one is ongoing, are of particular significance because of their scopes and results.

A cooperative study of rehabilitation practices in the late 1960's and early 1970's resulted in several recommendations which are still generally practiced in reclamation today. Among these are face slopes of dumps no steeper than 2½ to 1, stoping of dumps and fills toward undisturbed ground to prevent downslope runoff, placing of waste materials most conducive to vegetation growth on dump surfaces, use of 8 inches or more of topsoil or other soil-like material for surfacing, application of fertilizer, and recommendations of species of trees, shrubs, grasses, and forbs best suited for revegetation.

A study of slope stability of spoil dumps, completed in 1974, concluded that waste dumps with a face slope of 3 to 1 or less would not be subject to massive failure even under adverse conditions such as saturation.

Ongoing experiments under the Forest Service Surface Environment and Mining (SEAM) program, are utilizing field plots to study such aspects of rehabilitation as the microflora and microfauna in dumps; use of organic additives and chemical fertilizers; performance of various grasses, forbes, shrubs and trees, both indigenous and ixotic; use of hydromulch; effect of mining and post-mining management on plant succession in a natural ecosystem; and testing and evaluation of various instruments, tools, equipment, methods, and procedures currently used or possibly applicable to revegetation and reclamation.

The Mining Enforcement and Safety Administration (MESA) of the Department of the Interior has conducted health and safety inspections of the southeastern Idaho phosphate mines since 1970. Operations with 50 or more employees are inspected at least twice a year, with as many followup inspections as necessary. The smaller operations are inspected at least annually.

The phosphate mines have established health and safety programs and have cooperated with MESA in the enforcement of Federal health and safety standards. In addition, operators and employees have participated in various health and safety training courses and seminars offered by MESA's education and training division.

Generally, the phosphate operations have a good health and safety record. Some mines have outstanding records and have received awards and recognition from various safety organizations. Preliminary statistics on injuries are shown in table 1-24. There were no fatal injuries during this period.

2. Phosphate Processing

a. Fertilizer plants

There are two integrated fertilizer plants presently operating is southeastern Idaho. Basic raw materials for these plants are sulfur, natural gas, and phosphate rock. Sulfur produced from sour gas is imported into the State from Canada, Montana, Wyoming, and California.

The J. R. Simplot Company has operated a completely integrated fertilizer complex at Pocatello, Idaho since 1945. The plant processes about 750,000 tons of phosphate rock per year. About 300,000 tons of high-grade rock (plus 31 percent P_2O_5) is shipped by rail from the Gay mine about 30 miles northeast of Pocatello on the Fort Hall Indian Reservation. An additional 450,000 tons of sized concentrate is shipped to the plant throughout the year by rail from the Company's mining-beneficiation operation at Conda, Idaho.

The second fertilizer plant, located at Conda, Idaho, is operated by Beker Industries, Inc. (formerly Agricultural Products

Table 1-24.--Employment and injury statistics, Idaho phosphate industry, 1973 and 1974.

Years	Count of operations	Men	Man-hours	Nonfatal disabling injuries	Nonfatal [a] disabling frequency rate	Non-disabling injuries	Nondisabling [a] frequency rate
1973							
Surface---	6	466	929,175	4	4.30	13	13.99
Mill------	1	23	47,173	-	-	-	-
Total--	7	489	976,348	4	4.10	13	13.31
1974							
Surface---	6	509	988,521	10	10.12	5	4.05
Mill------	1	20	34,585	-	-	-	-
Total--	7	529	1,023,106	10	9.77	5	3.91

[a] Only injuries with matching man-hours are included
Source: Mine Enforcement and Safety Administration, U.S. Dept. of Interior

Company). The plant, built in 1945 and operated by El Paso Products Company until 1967, includes washing, sizing, drying, and calcining. Phosphate rock is obtained from the Maybe Canyon mine. Rock with an average grade of 25 percent P_2O_5 is shipped by rail 26 miles to the plant. Rock is beneficiated to plus 31 percent P_2O_5 in the washing-sizing plant.

Beker operation of the plant began in 1972. In 1973, 1.8 million tons of rock was mined in 1974 2.2 million tons.

A fertilizer complex includes several operations and plants. Among these are (1) calcining, (2) sulfuric acid, (3) ammonia, (4) phosphoric acid, (5) triple superphosphate, (6) ammonium phosphate, (7) ammonium sulfate, (8) urea nitrate solution fertilizer, and (9) liquid fertilizers. Operational procedures and products from the two fertilizer plants in this area are basically similar, except that the Beker plant does not now produce ammonium sulfate or the urea-base solution fertilizers.

b. Elemental phosphorus plants

There are two elemental phosphorus plants presently operating in southeastern Idaho. These are the FMC plant of Pocatello and the Monsanto Chemical Company plant north of Soda Springs. Most of the phosphorus produced at these plants is used in detergents, cleaning agents, and other household products, including numerous food products.

The FMC elemental phosphorus plant, the larger of the two, started in 1949 with one electric furnace producing about 16 million pounds of phosphorus per year. A second furnace was installed in 1950, a third in 1951, and a fourth in 1952. Having a combined design rating of about 220 megawatts, the four furnaces now have a combined production capacity of 280 to 290 million pounds annually.

The FMC plant uses about 1.8 million tons of phosphatic shale, 190,000 tons of coke, and 130,000 tons of silica each year. The coke is shipped in by rail, with about half coming from a company-owned coking plant near the Kemmerer, Wyoming coal fields, and the remainder from other sources. The silica, in the form of quartzite (SiO_2) pebbles and cobbles, is recovered by FMC from the valley alluvium adjoining the Portneuf River, on company land near the Pocatello plant-site.

Phosphatic shale for FMC furnace feed has a 24 to 25 percent phosphorus pentoxide (P_2O_5) content following crushing and blending. About 1.8 million tons of plant-feed shales are supplied annually from the Gay mine on the Fort Hall Indian Reservation. The ore is transported by rail to plant stockpiles, a distance of about 30 miles, from May through October. During this period, nearly two dozen 82-ton Union Pacific gondola cars are loaded each hour of a 10-hour work day, and the ore is transported in 100-car units at the rate of two per day Monday through Friday and one per day on Saturday.

The elemental phosphorus produced at FMC's Pocatello plant is shipped to company-owned phosphorus-burning plants in California, Kansas, New Jersey, and Wyoming, where it is converted into phosphates used in a wide variety of household and other products.

The second elemental phosphorus plant, located about two miles north of Soda Springs on Highway 34, is operated by Monsanto Chemical Company Plant operations started in 1952 with one electric furnace. A second furnace and a rotary kiln were installed in 1954-55, giving the plant an annual production capacity of about 92 million pounds of elemental phosphorus. A new rotary kiln was built in 1965 to furnish burden for three furnaces, and the third furnace was completed in 1966. The older of the two kilns has been dismantled. Presently, with the three electric arc furnaces having a combined design rating of 156 megawatts, the plant produces about 200 million pounds of elemental phosphorus annually.

Annual consumption of raw materials to support this operation includes about 1.0 million tons of phosphate rock, 150,000 tons of coke, and 250,000 tons of silica. The phosphatic shale is supplied from the company-owned Henry mine about 17 miles north of the plantsite. The silica is quarried from a massive, nearby, company-owned-and-operated quartzite deposit containing millions of tons of reserves. Coke is shipped in by rail.

Phosphatic shales for plant feed were originally supplied from the Ballard mine, which commenced operations in 1952 at its openpit operation about 10.5 miles north of the plant site. Production from the open-pit Henry mine, located only about 6 miles farther to the north, was started in 1969 to supplement dwindling supplies. With the Ballard mine now essentially mined out and inactive, plant feed blended to a uniform 25 to 26 percent P_2O_5 is totally supplied from the Henry mine. Ore is delivered to the plant over a private haul road, using triple trailer units, each trailer carrying 70 tons of ore. Four truck-trailer units of this type are presently in operation, each carrying 210 tons of ore per unit haul. Prior to haulage to the plantsite, the ore is passed through a trommel and over screens to eliminate the limestone and make a uniform material for blending. As with the FMC operation at Pocatello, the ore is hauled mainly during the summer months and is stockpiled at the plantsite for year-round plant operations.

The 220 million pounds of elemental phosphorus produced at this operation is shipped to company-owned phosphorus burning plants in St. Louis, Missouri, Long Beach, California, and Trenton, Michigan, where it is converted into phosphates used in a wide variety of household and other products.

The operational procedures employed at the two thermal reduction plants in this area are basically similar, except for the pretreatment calcining step.

The molten residuals at the bottom of the furnaces, ferrophosphorus and calcium silicate, are periodically tapped at regular intervals. At the FMC plant, the molten ferrophosphorus (which averages 4 to 5 percent vanadium, V), is collected in chill molds, custom-crushed, and shipped by rail--about 15,000 tons per year to east coast vanadium producers--mainly to Union Carbide Corporation in Arkansas--and about 5,000 tons per year to the Kerr-McGee plant at Soda Springs. Annual production of ferrophosphorus by FMC is about 20,000 tons. Monsanto's ferrophosphorus production, about 8,400 tons per year and averaging about 7 to 8 percent vanadium (V), is processed at the Kerr-McGee vanadium plant, which is about 0.5 mile from the Monsanto plant in the Soda Springs area.

Molten calcium silicate slag is discharged from the furnaces directly to a cooling pit where it is cooled by water spray, loaded onto trucks, and hauled to an onsite stockpile. Crushed slag is used as construction aggregate in concrete and asphalt paving, as a highway surfacing material, and as railroad ballast. Annual production of calcium silicate slag by FMC is about 1.5 million tons, of which Bannock Paving Company presently consumes about 800,000 tons for local markets.

Annual production of slag at the Monsanto plant is about 900,000 tons, of which Johnson Slag Products Company presently consumes about 160,000 tons for local markets. In both operations, the supply exceeds the demand, and company slag piles are correspondingly growing larger. The freight rate and other transportation costs severely limit the marketing distance, but one new outlet recently developed in the Twin Falls area. Prices received for this low-unit-value material generally range from about 50 cents per ton for pit run to about $2.25 per ton for the finer sizes of crushed/screened material.

Most of the potentially valuable trace elements, other than vanadium, are contained in the furnace dust, which is stockpiled for possible future byproduct recovery of trace elements. At the Monsanto operation, the dust slurry is pumped directly to storage ponds. At the FMC plant, the dust slurry is passed through a newly installed fluid-bed dryer, and the resulting "prill dust" is stockpiled for possible recovery of gallium and other valuable trace elements based on Company research which has been in progress for quite sometime.

c. Beneficiation plants

Two phosphate rock beneficiation plants are located at Conda, operated by Simplot and Beker respectively. Present washing-sizing operations are designed to upgrade altered phosphate ores from 20 to 25 percent P_2O_5 to plus 31 percent P_2O_5 required for acid-grade fertilizer plant feed. Operators now are considering plant expansion to include a selective flotation step for beneficiation of lower-grade altered and unaltered ores. Mill shales, presently being stockpiled at mining sites, are generally considered to range from about 14 to 22 percent P_2O_5 under present conditions, while low-grade rock ranges from about 10 to 14 percent P_2O_5. The present Beker processing mill also includes a calcining plant in addition to the basic washing and sizing plant.

The J. R. Simplot beneficiation plant at Conda upgrades ore to plus 31 percent P_2O_5, prior to shipping it to its fertilizer plant in Pocatello.

The second beneficiation plant, originally built by Mountain Fuel and Supply Company in 1966, currently is operated by Beker Industries, Inc. and beneficiates ore from the Maybe Canyon mine. Rock averaging about 25 percent P_2O_5 is beneficiated to plus 31 percent P_2O_5, and is then processed in the adjoining Beker fertilizer plant.

Beneficiation procedures at the two plants are basically similar and involve washing, scrubbing, crushing, grinding, sizing, and drying. Grade of plant feed is maintained at 24 to 25 percent P_2O_5 by blending.

d. Vanadium plants

The Kerr-McGee vanadium plant, which opened in 1963, is located about two miles north of Soda Springs. It processes vanadium-bearing ferrophosphorus produced by Monsanto Chemical Company and FMC as byproducts of their elemental-phosphorus plant operations, into three marketable products--vanadium pentoxide (V_2O_5), decomposed ammonium metavanadate (V_2O_5), and ammonium metavanadate (NH_4VO_3). Total annual production amounts to about 2.5 million pounds V_2O_5 equivalent (1.4 million pounds vanadium equivalent).

The plant consumes about 13,700 tons of ferrophosphorus per year, of which about 8,400 tons comes from Monsanto and about 5,300 tons from FMC. Ferrophosphorus plant feed normally ranges from 7 to 8 percent V_2O_5 for FMC material and 12.5 to 14 percent V_2O_5 for Monsanto material. Other basic raw materials needed in the manufacturing process and the quantities consumed annually are limestone (about 14,000 tons), common salt (about 2,000 tons), and soda ash (about 2,000 tons). To fulfill plant requirements for limestone, Kerr-McGee operates a limestone quarry southwest of the North Trail Canyon property, about six miles from the plant. Common salt and soda ash, also needed in the process, are purchased from outside sources.

The bulk of Kerr-McGee's vanadium products are purchased by U.S. alloy and chemical companies, and minor amounts by various foreign manufacturers, including Canada and Mexico. The products are shipped mainly by rail and motor freight, with the products packaged in steel and fiber drums.

e. Radioactive elements in phosphate rock products

The phosphate ore of the region is slightly radioactive due to the presence of small amounts of uranium and thorium, about 110 and 10 parts per million, respectively. The radioactivity of uranium and its decay products is of most significance. Three uranium isotopes are present: U-238, U-235, and U-234; U-238 constitutes 99.3 percent of the total uranium and is, along with its decay products, the principal producer of the observed radioactivity. The decay products of most concern are radium-226, radon-222, polonium-210, and thorium-230. In the processing of ore, U-238 and its decay products tend to separate and go to different mill products and effluents, as described below and to the extent that is presently known. The U. S. Environmental Protection Agency and the Idaho Department of Health and Welfare are currently studying the radiological impact of the phosphate industry in the region. This will include an evaluation of the radiological hazard associated with the reclamation of old plant sites, particularly slag dumps, which might be used by the public in the future.

In the wet processing at fertilizer plants, all evidence indicates that radium is removed from the product phosphoric acid, remaining with the gypsum which is discharged to settling ponds. Based on analyses by the Idaho Department of Health and Welfare (table 1-24a), waste-product gypsum from an Idaho fertilizer plant has a concentration of 12 ± 1 pCi/g (pCi = picocurie = 10^{-2} curies). EPA studies (1974) showed slightly higher concentrations, ranging from 15 to 30 pCi/g, with a sample from Simplot's Pocatello plant showing a concentration of 16 p Ci/g. No byproduct use is being made of the waste gypsum, and it is kept isolated within the plant area, with no radiation hazard being evident. Water seeping through the gypsum settling ponds, however, could in time leak and transport significant quantities or radium-226 unless properly sealed. Radium-226 has a half life of over 1600 years, and its maximum permissible concentration in water for the general population is 3.3 p Ci/l. Some Po-210 is lost in stack emissions in the calcining process, but the exact amount is not known at this time.

In table 1-24a, the fertilizer product which contains only 1 pCi/g of Ra-226 is an ammonium phosphate product made by combination of phosphoric acid and ammonia. The reason for the very low radium content is that the Ra-226 was removed in the gypsum product resulting from production of the phosphoric acid. The other fertilizer product containing 10 ± 1 pCi/g of Ra-226 is a tripple-superphosphate product made by combining phosphoric acid and raw ore. Thus, it is the addition of raw ore in this latter process that results in the moderatly increased radium content of the tripple superphosphate product.

The disposition of the radioactive elements, U-238, Ra-226, Po-210, and Th-230, in products of the electric furnace method of producing elemental phosphorus is shown in Table 1-24b. U-238 is split between the slag and ferrophosphorus products, Ra-226 is concentrated in the slag, most of the Po-210 is included in the fluid-bed material that is collected from the stack emissions, and most of the Th-230 goes into the slag. The fluid-bed material is small in amount and is stockpiled near the plant. The ferrophosphorus is shipped to other plants for the recovery of its vanadium content.

The slag, which contains the radium-226, has in the past been used by the construction industry as building aggregate, for road beds, and for railroad ballast. Its use as aggregate in the construction of habitable buildings has posed the most serious radiological problem due to the decay of the radium to radon-222, a gas, and the possible inhalation of the gas. The radon, with a half life of 3 days, itself decays with the emissions of alpha particles that can damage the lung and induce cancer when present in large enough quantity. It is because of this hazard that the State intends to prohibit the use of slag for most purposes.

Table 1-24a.--Radium content of products and by-products from thermal and wet process plants

Slag 1 and 2 are composite samples from two different thermal-process plants. Ore 1 and ore 2 are composite samples from these same two plants. Ore 3 is a composite from a wet process plant ore pile. Fertilizer 1 is an ammonium phosphate product, and fertilizer 2 is a triple-superphosphate product. Errors are one sigma due to counting statistics. A curie is the radioactivity of 1 gram of radium. A picocurie (pCi) equals 10^{-12} curries; and pCi/g equals picocuries per gram. (Source: Radiation Control Section, Idaho Dept. of Health and Welfare).

Sample	Ra-226 (pCi/g)
Slag 1	39 ± 2
Slag 2	41 ± 2
Gypsum	12 ± 1
Fertilizer 1	1
Fertilizer 2	10 ± 1
Ore 1	36 ± 2
Ore 2	26 ± 2
Ore 3	21 ± 1

Table 1-24b.--Radioactivity content of thermal-process samples (pCi/g)

Ore is as it comes to the plant. Nodule is the calcined ore. Slag is the main waste product from electric furnaces. FEP is the ferrophosphorus product, dense metallic bottom layer of the furnace melt. Fluid bed material is essentially dust collected from the clean up of volatilized phosphorus. A curie is the radioactivity of 1 gram of radium. A picocurie (pCI) equals 10^{-12} curies; and p Ci/g equals picocuries per gram. Errors are 2 sigma due to counting statistics. (Source: Radiation Control Section, Idaho Dept. of Health and Welfare).

Sample	U-238 (pCi/g)	Th-230 (pCi/g)	Ra-226 (pCi/g)	Po-210-(pCi/g)
Ore	22.0 ± 0.4	21.0 ± 0.4	26.0 ± 0.9	25.0 ± 1.8
Nodule	23.0 ± 0.5	24.0 ± 0.5	26.0 ± 0.9	22.0 ± 1.3
Slag	30.0 ± 0.5	20.0 ± 0.4	35.0 ± 1.0	7.5 ± 0.2
FeP	30.0 ± 0.7	0.2 ± 0.1	0.3 ± 0.1	3.2 ± 1.1
Fluid Bed	1.3 ± 0.1	3.0 ± 0.2	11.0 ± 0.6	1300.0 ± 80.0

Although the Environmental Protection Agency indicated in September 1975 that there appeared to be no health problems associated with processing of phosphate rock at that time, further studies are being conducted to evaluate the full effect. Radioactivity in ambient air as a result of processing is discussed in the air quality section of this chapter.

d. Controls and Constraints

Generally speaking, land use controls in the study area have been slow in coming, but now concerned governmental officials at Federal, State, and local levels are involved in some form of land use planning, with attendant controls.

1. Federal Controls

Federal involvement includes the Caribou National Forest on reserved National Forest Lands, the Bureau of Land Management on National Resource Lands, and the mineral estate under certain State and privately owned lands. The U. S. Geological Survey has responsibility for supervising operations concerned with discovery, development, and production of the phosphate resource from Federal lands and mineral estates. Fish and Wildlife Service exercises controls over withdrawn wildlife refuges.

Management policy has been extended in greater detail to all these agencies by the National Environmental Policy Act of 1969. Under certain conditions, there is a joint or multi-agency sharing of particular management and control responsibilities.

While the planning activity and its eventual land use controls are being developed, these agencies continue issuance (if feasible) of a variety of leases, permits, and licenses. Controls over these various land uses are of a discretionary nature in the form of stipulations imposed by the responsible agency official.

a. National-forest lands

Basic land use controls over the national-forest lands within the study area are conducted under the Organic Administration Act of 1897, and the Multiple Use Sustained Yield Act of 1960. Legislation, policy, and regulation provide firm and specific bases for administration of surface resources, including recreation, forage, timber, wildlife and fishery resources. Mineral-resource administration is generally shared between the Bureau of Land Management and the U.S. Geological Survey. Mineral administration is complex and is usually related to the surface-resource values.

Forest Service personnel on the Idaho Falls, Soda Springs, and Montpelier Ranger Districts execute administrative policy and regulations in the study area's national-forest lands. District personnel are directed by a directives system of policy and regulations entitled "Forest Service Manual". In addition, each District is guided by Ranger District

Multiple Use Plans (RDMU plans). RDMU Plans are coordination documents that describe specific district lands and set coordination requirements for use of these lands.

RDMU plans were prepared in the early 1960's by Ranger District personnel to implement Public Law 86-517 (Multiple Use Sustained Yield Act of 1960). Plans for each of the three involved ranger districts are in use, but they need updating through the land use planning process. These plans are currently in accordance with a December 1965 Multiple Use Management Guide for the Intermountain Region of the Forest Service.

A system of land use plans is being instituted to refine the RDMU Plans and set forth more completely long-range programs for management. A land use plan for part of the national-forest lands in the study area, designated the Diamond Creek Planning Unit is in the preliminary stages. This land use plan is intended to broadly allocate lands and resources. It will be refined and completed following completion of this EIS. The land use plan for the Diamond Creek unit will include all proposed on-forest mines and all but a few thousand acres of prospecting permit and lease applications.

Inventory data have been assembled and partially analyzed. Further efforts were deferred in August 1975, pending completion of this EIS. Inventory information for the land use plan has been available to and used by the Task Force. Several Task Force members were also members of the Land Use Study Team, including a soil scientist, a wildlife biologist, a hydrologist, a forester, a range conservationist, and a landscape architect.

b. National-resource lands

Traditionally, the National Resource Lands under jurisdiction of the Bureau of Land Management have been the subject of various forms of applications under a variety of agricultural land laws, public sales, and exchanges, etc. However, with the passage of the Classification and Multiple Use Act of 1964, land areas and specific tracts were classified either for disposition or retention for multiple use management. All the National Resource Lands within Bear Lake and Caribou Counties have been so classified. However, those National Resource Lands of Bingham, and Bonneville Counties within the study area were not classified before the Act expired in 1970.

Like the Forest Service, the Bureau of Land Management is in various stages of developing land use plans for three different Planning Units (Grays Lake, Caribou, and Bear Lake) within the study area. The first phase of the planning system (Unit Resource Analysis) consists of: (1) an inventory of the natural-resource base (land, minerals, watershed, forage, timber, recreation, wildlife, open space, and visual resource values) through consultation with the public and organized groups; and (2) identification of the potential development of each resource without regard to the influence on or by the other resources.

The Bureau of Land Management is currently developing Unit Resource Analysis information and is all participating in the preparation of this EIS. The second phase (Management Framework Plan) identifies and resolves the different resource conflicts and identifies various management alternatives.

The public is invited to participate through the entire planning process to assure the decisionmaker that all the known facts are available, and that the needs and desires of the public are considered --- for each resource. With the inventory, analysis, recommendations and alternatives, the decisionmaker is then prepared to put the plan into action in the implementation phase.

These various unit plans will not be completed until after the Environmental Impact Statement is completed. In the Bureau of Land Management, the Management Framework Plan is the decisionmaking document. The ultimate management of the National Resource Lands within the study area will, therefore, be based on the Management Framework Plans of the Grays Lake, Caribou and Bear Lake Planning Units.

The Mineral Leasing Act of 1920 gives the Bureau of Land Management the responsibility to determine if the federally-owned minerals shall be leased and, if so, under what terms and conditions. Under this authority, it receives and processes permit and lease applications on all Federal lands and Federal mineral estate and takes necessary action leading to the issuance or rejection of these applications.

c. U. S. Geological Survey

The U.S. Geological Survey's Conservation Division has supervisory responsibilities over operations concerned with the discovery, development, and production of phosphate resources from Federal lands and the Federal mineral estate from certain private and State-owned lands.

Responsibilities include classifying, investigating, and reporting on applications for leases and prospecting permits and recommending lease terms to the Bureau of Land Management, enforcing compliance with lease terms and regulations governing the conduct of prospecting, mining, and beneficiation; protecting and conserving the natural resource by preventing waste; determining royalty liability; preparing statements; receiving payment of royalties and rentals; and acting in an advisory capacity to the Secretary of the Interior, other bureaus of the Department, and other government agencies.

d. Fish and Wildlife Service

The Fish and Wildlife Service exercises land use controls over two Wildlife Refuges within the study area. The Bear Lake National Wildlife Refuge located at the north end of Bear Lake in Bear Lake County, contains 17,573 acres of marshlands. The Grays Lake National Wildlife Refuge, adjacent to Grays Lake in Caribou and Bonneville Counties, contains 16,718 acres of marshlands; this area could be doubled if existing plans materialize.

The refuge manager exercises control over and issues certain types of permits, leases, and agreements, for such things as grazing, hay production, and trapping. This type of arrangement is desirable for preventing fire hazards, stimulating plant growth, scientific research, and economic benefits to permittees.

The Fish and Wildlife Service also administers the Endangered Species Act of 1973, which provides for the conservation of endangered and threatened species of fish, wildlife, and plants. It also provides, through federal assistance, a system of incentives to develop conservation programs to meet the national and international standards. Section 7 of the Act states that the Secretary of the Interior shall review other programs administered by him and utilize such programs in the furtherance and purpose of the Act. It also states that endangered species and threatened species be protected through such action necessary to insure the continued existence of such endangered species and protection of their habitat as deemed critical in consultation with the appropriate States.

Under the Fish and Wildlife Coordination Act of 1958, the Fish and Wildlife Service investigates various water-related actions which may cause detrimental effects to fish and wildlife resources. It cooperates with other federal, state, and private agencies for the investigation into various fish and wildlife habitat programs. Under the provisions of this Act, the Secretary of the Interior, through the Fish & Wildlife Service and the Bureau of Mines, is authorized to make such investigations as he deems necessary to determine the effects on wildlife of such impacts as domestic sewage, mine operations, petroleum and other industrial wastes, and silt and other polluting substances.

e. Bureau of Indian Affairs

Lands withdrawn from the public domain for reservair purposes for Grays Lake and Blackfoot Reservoir have surface use rights administered by the Bureau of Indian Affairs. Permits or leases are entered into for grazing, farming, public use sites, concessions, and other purposes.

Some of the land in the Grays Lake area is dedicated for both reservoir and wildlife refuge purposes. Surface use of these lands is governed by an agreement between BIA and USFW, with permits issued by the agency responsible for the specific land to be permitted.

2. State Controls

The subsurface estate vested in State or private ownership is governed by applicable statutes of the State of Idaho.

Within the study area, about 233,000 acres of State-owned land is administered by the Idaho Department of Lands. That department issues leases and permits governing the use and disposition of a variety of natural resources to individuals, groups, and agencies. Jurisdiction over the various uses are identified by various State Statutes.

The Idaho Department of Health and Welfare, Division of Environment, has the following controls and regulating powers:

Septic Tank Permits - the state regulates the installation and use of septic tanks. This authority has been delegated to the district health departments.

Sanitary Restrictions on Subdivisions - plans for subdivisions need to be approved by the Department to assure that plans and specifications for sewer systems have been approved.

Review of Plans & Specifications - all plans and specifications for new and/or modified wastewater collection or treatment facilities must be approved by the state before construction can begin.

Environmental Impact Statement (EIS) Review - the department reviews and comments on the technical and legal adequacy of EIS's prepared by Federal agencies.

Non-Point Source Controls - the state will do the planning and develop programs for the control of non-point sources of pollution on areas not designated for 208 planning. (Bannock and Caribou counties have been designated via SICOG to do their own 208 water quality planning).

Certification of Federal Licenses - makes sure issuance of a license does not violate any state air and water quality standards.

Wastewater Discharge Permits - under new regulations effective January 1, 1977, permits will be required for wastewater discharge from both point (excluding discharges to surface water) and non-point sources.

Antidegraetion Requirements - new or increased pollutant discharge from industrial, public, or private projects or developments to either surface or underground high quality waters must be approved by the Idaho Department of Health and Welfare.

The Department of Water Resources has a variety of duties and responsibilities. Those which might affect the phosphate mining area include:

(1) Provide the data, information, and staff support to the Water Resource Board for the formulation and implementation of the State Water Plan.

(2) Administer the water laws and supervise the distribution of surface and groundwater.

(3) Supervise the preparation of reports to the District Courts for the adjudication of water rights.

(4) Protect from contamination the groundwater by supervising the construction and use of water wells and waste disposal and injection wells.

(5) Protect public safety through the approval of plans and specifications of proposed dams and inspection of all existing dams.

(6) Manage and protest the state's geothermal resources.

(7) Protect streams from unnecessary or improperly designed channel alterations through a permit program.

3. Regional Controls

District Health Departments exert controls over lot sizes as they relate to individual sewer (i.e. septic tanks) and water systems. The Division of Environment of the Idaho Department of Health and Welfare has the responsibility of certifying all municipal sewer and water systems.

Two Councils of Government (Bonneville Council of Governments and Southeast Idaho Council of Governments) have been organized and are in the process of assisting county governments develop comprehensive plans and zoning ordinances. No implementation authority rests in the Councils of Government.

Bear Lake County has created with Rich County, Utah, the Bear Lake Regional Commission to plan development adjacent to or affecting the water resource values of Bear Lake.

4. Local Controls

In Idaho, counties have been given authority to exercise land use controls over unincorporated private lands. They are required to adopt comprehensive plans and to enact zoning and subdivision ordinances. This is a new requirement of the "Local Planning Act of 1975", which went into effect July 1, 1975 (Title 67, Idaho Code).

Table 1-25 lists the extent of the planning capabilities and various ordinances and control capabilities for each county and its incorporated areas. Although counties have planning and zoning commissions, they are only an advisory body to the Board of County Commissioners. Ultimate control jurisdiction rests with the county commissioners, and ultimate control within incorporated municipalities rests with the city councils.

Four out of the eight counties have Comprehensive Plans which include comprehensive plans for more than half of the cities within the area (table 1-25). The new Local Planning Act of 1975 will require the four counties to update their plans by January 1, 1977. Other provisions of the law require those units of local government that do not have existing plans to comply with the law no later than January 1, 1978 (Section 67-6526, Areas of City Import-Negotiation Procedure).

Even though a large number of the local units within the eight-county study area have ordinances covering either zoning, subdivision, or building codes, they do not presently possess the local staff necessary to adequately monitor ordinance enforcement. This puts the local level in a position of not possessing the necessary local staff to carry out existing ordinances. For example, only four units--Bonneville County, Idaho Falls, Bannock County, and Pocatello--possess all the full-time staff involved in ordinance enforcement.

2. SOCIOECONOMIC DEVELOPMENT

Data in this section have been extracted from a report prepared under contract by the Southeast Idaho Council of Governments (SICOG) for the Task Force (1975a, b). The actual study was conducted by the Government Research Institute at Idaho State University, and the report was prepared jointly by the Institute and SICOG. It covers a seven-county area including Bannock, Bear Lake, Bingham, Caribou, Franklin, Oneida, and Power, with data for Bonneville County included where available.

a. Population

The eight counties, comprising an area of 11,022 square miles, had a combined population of 163,400 in 1970, up 6.2 percent over 1960. Most of the population increase occurred in the northern counties of Bannock, Bingham, Bonneville, and Power, although Caribou County also increased during this period and currently is reflecting a pattern of growth in anticipation of increased development of the phosphate industry. The remaining three rural counties recorded a net decline in population between 1960 and 1970. However, this decline may have leveled off, owing in part to the spillover effect of growth in nearby areas. The increase in population in Logan, Utah, for example, has had an impact upon the population in bordering Franklin County. Forecasts by the Southeast Idaho Council of Government (SICOG) indicate population increases in nearly all of the eight counties during the next decade.

The 1970 data do not account for the additional impact in Bannock, Bingham, and Power Counties of the Bucyrus-Erie plant located in Pocatello in 1974. The Department of Economics at Idaho State University has forecast a population increase in Pocatello of approximately 30,000 by 1980 as a result of the Bucyrus-Erie plant. The figures of the Economics Department have been surrounded by controversy in that they appear to be too high. The medium figures for Bannock and Caribou Counties are generated through the Income; Population and Employment Forecasting Model (IPEF). With the phosphate impact in Bannock County smaller, in comparison with Caribou and Bear Lake Counties, the population figures for Bannock County are primarily Bucyrus-Erie impact. The

Table 1-25.--Planning capabilities and controls of counties and incorporated areas

Key:

x = completed
I = in process
m = member/SICOG or BCOG
2 = number of full-time staff in ordinance enforcemt.

	ORGANI-ZATION				PLANNING								IMPLEMENTATION											
					Comp.1				Functnal.2				Ord.3			Codes					Other			
LOCALITY	P & Z commission	regional plng comm	counc. of govnmts	development assoc.	"701"	locally funded	areawide	single unit	sewer/water	transportation	open space	housing	zoning	subdivision	mobile homes	building	housing	sanitation	plumbing	electrical	model cities	shoreline	hsng. authority	ttl. staff to monitor4
BANNOCK	x		m		x		x		x				x	x	x									2
Arimo			m		x				x															
Chubbuck	x		m		x				x	I			x	x	x	x								
Downey			m		x				x				x			x			x	x				
Inkom					x				x				x			x		x	x	x				
McCammon					x				x				x	x	x				x	x				
Pocatello	x		m	x	I				I	I			x	x	x	x		x	x	x				9
BEAR LAKE	x	x	m		I	x	I		x									x				x		
Montpelier		x	m		I		I		x															
Paris		x			I		I		x															
St. Charles		x	m		I		I		x															
Fish Haven		x			I		I		x															
BINGHAM	x	x	m		x	x	x						x	I									x	
Aberdeen	x	x	m		x	x			x				x											
Blackfoot	x	x	m		x	x			x				x	x	x	x		x	x	x				
Shelley	x		m		x	x			x				x		x	x			x	x				
Firth									x															
CARIBOU	x	x	m		x	x	x		x				x	x				x						
Grace	x	x	m		x	x			x				x	x		x		x	x	x				
Soda Sprgs.	x	x	m		x	x			x				x	x										
Bancroft	x	x	m		x	x			x				x	x										
FRANKLIN	x		m		I	x	x		x				I	I										
Franklin	x		m		I	x			x					I										
Preston	x		m		I	x			x				x	x		x		x	x	x				
ONEIDA	x		m						x															
Malad	x		m						x				x		x	x		x	x	x				
POWER	x		m		I	x	x		I															
Am. Falls	x		m			x			I				x		x	x		x	x	x			x	
Rockland			m						I															
BONNEVILLE	x		m		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x				2
Ammon	x		m		x	x	x		x	x	x		x	x	x	x	x	x	x	x				
Idaho Falls	x		m		x	x	x		x	x	x		x	x	x	x	x	x	x	x				8
Iona			m		x	x	x		x	x	x		x											
Ucon			m		x	x	x		x	x	x		x											

SOURCE: Southeast Idaho Council of Governments

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[1] Comprehensive Plan

[2] Functional Plans

[3] Ordinances

[4] Technical staff to administer ordinances and codes

high figures for Bannock, Bear Lake, and Caribou Counties are based on the multiplied method. IPEF results for Bear Lake County have not been completed. See table 1-26.

In 1970, most of the population outside of Bannock, Bonneville and Power Counties lived in communities will less than 2,500 people or in rural farm settings. This characteristic reflects the nonurban features of families living on the Fort Hall Indian Reservation and the rural setting of the southern counties. Oneida County, with no community classified as urban by U.S. Census definitions in 1970, represents the extreme in the region. The sparsely-distributed population of the area has encouraged development of individualized or small collective water and sewer systems, many of which are inadequate and fail to meet current standards. It is estimated that the immediate cost of updating existing water and sewer systems in the eight-county area will exceed $22 million.

The largest minority group in the region consists of native Americans located mainly in Bingham County. The second largest ethnic group are those with Spanish surnames, also located primarily in Bingham and Power Counties. Uncharacteristic of the region is Bonneville County where the largest ethnic group is of Japanese ancestry.

The fastest growing age group in rural areas is the elderly, 65 or older. It comprises 16 percent of the population in Oneida County and 13 percent in Franklin County. In the more urban counties of Bannock and Bingham, more than 15 percent of the population is 55 and older.

Out-migration has been a significant determinant of population growth in southeast Idaho. An out-migration of 21,625 people between 1960 and 1970 was offset by a high birth rate, resulting in a net growth of some 10,000 persons. If the impacts of new industry in Pocatello and Caribou County stem the outward migration and attract new families into the region, the growth rate of the past will be a poor indicator of the rapid population growth that is likely to occur.

b. Employment

Agriculture is the primary industry in southeast Idaho, with two-thirds of the land in the region devoted to irrigated or dry cropland or to rangeland. The size of the labor force employed in trade, service, manufacturing, and government-education, however, exceeded that of agriculture in 1970. Table 1-27 summarizes the labor force statistics. Based on U.S. Bureau of Census figures, the unemployment rate in 1970 for the eight-county region was 4.5 percent. Idaho Department of Employment figures identify regional unemployment in 1970 at 6.1 percent unemployment was highest in rural areas. The impact of agriculture on total employment patterns is reflected by the fact that the unadjusted unemployment rate for October 1970according to Idaho Department of Employment, was 4.6 percent; for December, 5.7 percent; and for January, 6.2 percent respectively.

Table 1-26 Population of the study area, by counties

County-Region	Total Population				
	1950	1960	1970	1973	1974[1]
Bannock	41,745	49,342	52,200	54,500	55,200
Bear Lake	6,834	7,148	5,801	5,900	5,800
Bingham	23,271	28,218	29,167	30,800	31,900
Bonneville	30,210	46,906	52,457	54,800	56,000
Caribou	5,576	5,976	6,534	6,500	7,000
Franklin	9,867	8,457	7,373	7,500	7,600
Oneida	4,387	3,603	2,864	2,900	3,300
Power	3,988	4,111	4,864	4,900	5,000

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[1] Provisional

Sources: U.S. Bureau of the Census, Number of Inhabitants, Idaho (1960 & 1970)
Idaho Bureau of Vital Statistics, February 1975 (1973 & 1974)

Table 1-27. COMPOSITE LABOR FORCE, 8-COUNTY STUDY AREA.

General Category	1950	1960	1970
Agriculture, Forestry & Fishing	10,781	8,344	6,290
Mining	201	189	381
Construction	3,413	3,439	3,287
Manufacturing	2,487	6,432	7,520
Transportation, Communication	5,846	5,118	4,885
Trade	9,294	12,069	13,984
Finance, Insurance and Real Estate	990	1,770	2,133
Public Administration, Education	3,501	5,749	7,430
Services & Miscellaneous	4,249	7,891	8,220
Health Services	1,212	1,224	2,074
Occupation not otherwise reported	559	1,209	(1)
TOTALS	42,633	53,434	56,804

(1) This category was eliminated in 1970 and figures were included in specific employment categories in U.S. census reports.

Source: Southeast Idaho Council of Governments.

c. Income

In 1974, almost 25 percent of the people living in families in the area had annual incomes under $5,000, which was the Office of Economic Opportunity criterion for a poverty level income. At the present time no family with an income of $5,000 or less could afford to pay more than $104.25 (or 25 percent of income) per month for rent; this relationship of income to adequate living facilities, however, is only one measure of the impact of poverty. The median value of owner-occupied dwellings shows the average cost at $12,700. The median income of families in the region is $8,780.

More than 12 percent of the population live alone; of these, more than 40 percent have incomes below the poverty level. More than 4 percent of the urban population receive financial assistance in the form of aid to dependent children; a lesser percentage receive old-age assistance and aid to the permanently and totally disabled.

d. Housing

Housing is a major problem in the region. The private sector appears to be moving rapidly to try to alleviate the pressure created by an increasing population in the northern counties, but development lags behind demand. Currently, the percentage of households with more than 1.5 persons per room (the U.S. census definition of overcrowding) is high in all counties in the region. The situation is even more severe than these statistics indicate, because the number of households with only one occupant is very high. Relatively large numbers of households are greatly underutilized, many having only one resident who is elderly. This factor may distort percentages by underestimating the amount of overcrowding which exists within the region.

Generally, throughout the region there is an inadequate supply of vacant homes for rent or sale. Although housing is generally limited, it is especially serious at the low-income level. The sale of mobile homes as a substitute for stick-built housing is increasing rapidly in the region.

There has been a decrease in the last decade in the number of units lacking some or all plumbing facilities. The number of renter-occupied units without adequate plumbing in the urban areas indicates a significant problem yet to be solved. In the rural areas, the homeowner whose income is also low, has not been able to afford adequate plumbing. The supply of seasonal or migratory housing on the market has decreased throughout the area. This puts additional pressure on the existing housing supply during the period of high migratory labor in Bannock, Bingham, and Power Counties.

Farmers Home Administration has begun using its interest credit program to encourage the rehabilitation of existing rural houses. Under this program the size of the loan, so long as it is not more than $7,000. is not a factor in determining the amount of interest credit. Borrowers with adjusted incomes of less than $3,000 pay one percent interest; those with $3,000 to $5,000 income pay 2 percent; and those with $5,000 to $7,000 income pay 3 percent. The loans are repayable over periods up to 25 years and must be used to rehabilitate houses that will be occupied by the borrower and to bring a substandard dwelling up to minimum property standards. The interest credit program for rental housing in rural areas (population 10,000 or less) from Farmers Home Administration is also currently operational.

A survey was conducted of housing needs in the seven-county SICOG region in 1974. Of the 2,137 people who responded, (5 percent of the population), 75 percent of those under 60 and 85 percent of those over 60 owned their own homes. These statistics are reflected in the following survey results: Over 51 percent of those both under and over 60 responded that "deterioration" or substandard housing (e.g. overcrowding, plumbing, and heating) was a "fairly bad" problem in their communities. Over 61 percent of the under 60 and 57 percent of those over 60 rated the "lack of low income rental housing" as a "fairly bad to extremely serious" problem in their community.

Without public incentives or supports, it is not likely that the construction market can meet the housing construction needs in the future in the eight-county region.

e. Schools

Elementary and secondary school enrollment in the fall of 1974 totaled 43,267 for the 8-county area (table 1-28), down 1,267 from the 1973-74 school year. Expenditures for the 1973-74 school year were $38.9 million. Data on public school enrollment and financial statistics are given in table 1-29.

f. Community Attitudes

Currently there is no comprehensive regional source of citizens' attitudes across a broad spectrum of social issues. The best effort to this end is included in the Southeast Idaho Council of Governments (SICOG) Development Guide: Goals for Southeast Idaho published in June, 1974. The Citizen's Attitude Survey conducted by the Government Research Institute at Idaho State University and included in the Development Guide are summarized as follows.

During the spring of 1974, 10,000 questionaires were mailed to respondents in all seven counties of Region V with a total return of 2,137 (21.4 percent). The information was solicited by county and county seat, and by age groups.

Following are brief summaries on the issues of land use and health and citizens' opinions of their local communities. It should be pointed out here that despite these data, there is the paucity of comprehensive social attitudinal information for southeast Idaho and that the data does not include Bonneville County.

Table 1-28.--Elementary and secondary public school enrollments by county and region, Fall 1974

County	Elementary Grades 1-8	Secondary Grades 9-12	Total Enrollment
BANNOCK			
Marsh Valley (21)	916	501	1,417
Pocatello (25)	7,310	3,845	11,155
TOTAL	8,226	4,346	12,572
BEAR LAKE (33)	975	564	1,539
BINGHAM			
Snake River (52)	1,077	563	1,640
Blackfoot (55)	2,508	1,181	3,689
Aberdeen (58)	642	332	974
Firth (59)	532	311	843
Shelley (60)	1,153	579	1,732
TOTAL	5,912	2,966	8,878
CARIBOU			
Grace (148)	437	204	641
North Gem (149)	156	56	212
Soda Springs (150)	850	392	1,242
TOTAL	1,443	652	2,095
FRANKLIN			
Eastside (201)	1,066	564	1,630
Westside (202)	263	153	416
TOTAL	1,329	717	2,046
ONEIDA (351)	448	246	694
POWER			
American Falls (381)	875	422	1,297
Rockland (382)	97	56	153
Arbon (383)	17	-	17
TOTAL	989	478	1,467
BONNEVILLE			
Idaho Falls (91)	5,930	3,189	9,119
Swan Valley (92)	110	3	113
E. Bonneville (93)	3,227	1,517	4,744
TOTAL	9,267	4,709	13,976
8-COUNTY TOTALS	28,589	14,678	43,267

Source: Idaho Department of Education.

Table 1-29.--Public school enrollment and financial statistics, 1973-74

	Bannock	Bear Lake	Bingham	Caribou	Franklin	Oneida	Power	Bonneville	Total 8-County
Expenditures (millions)	11.60	1.16	8.50	1.78	1.68	.76	1.40	12.05	38.9
Expenditures A.D.A.	967	803	1,022	927	868	1,098	1,014	921	955
Full Term A.D.A	11,993	1,439	8,318	1,921	1,935	692	1,385	13,093	40,770
Enrollment	13,092	1,584	9,243	2,129	2,069	733	1,485	14,199	44,534
Assessed Valuation (millions)	60.2	13.3	52.3	25.3	6.2	9.2	29.1	74.4	273.0
Assessed Valuation A.D.A.	5,023	9,269	6,288	13,160	5,779	13,265	20,982	5,680	6,695
Bond Debt (thousands)	8,849	139	5,577	395	700	-	594	6,160	22,414

Source: Southeast Idaho Council of Governments.

Data on citizens' opinions concerning land use are not available by county; however, regional responses to the question of whether or not to reserve land best suited for agriculture solely for that purpose indicate that more than 85 percent favor such action. Of these citizens who desired to preserve agricultural land for agricultural purposes, further information is available on their response to the question of how they felt about specific kinds of construction on agricultural land if alternative sites were available. More than 90 percent felt that development should not take place on choice agricultural land if alternate sites are available. Included in the land use issue area were questions which solicited citizens' attitudes concerning the efficiency of local governments cooperating to serve community needs and an opportunity for the respondents to rank issues in which their local governments are involved according to their greatest need or need of improvement. Again, over 80 percent felt that regional cooperation among local governments could best achieve economy and efficiency.

The citizen survey also asked the citizens in Region V to rank health-problem issues according to their degree of concern and need for attention. Citizen response overwhelmingly listed alcoholism and/or drug abuse as most important.

The attitude survey concluded by asking the citizens in Region V for their opinions concerning (1) how well they like their community, (2) what their opinion is of their community's population and finally (3) their opinion of their community's future population rate of growth. Response in 14 communities in all cases were over 90 percent stating "alright" to "extremely well" for item (1). In all but 2 communities--Paris and Malad--more than two-thirds felt their community was "populated just right". Only in Pocatello did more people feel the community was overpopulated rather than underpopulated. More than half the residents felt that their communities should continue to grow at present rates. In the overall, about the same number felt growth should be faster as those that felt the community should remain as is--19 percent each. About 11 percent felt that communities should grow slower or reduce population.

g. Transportation

The study area is bounded on the west by Interstate 15 and minor arterial U.S. 26 on the north. The region includes approximately 108 miles of Interstate highway, 261 miles of U.S. highway, and 129 miles of State highway, according to Idaho Department of Highway data.

As more site-specific population distributions data become available, more statistical information will be needed on the collector routes that will be affected. For example, the use and adequacy of State Highway 34 between Soda Springs and Conda and the Blackfoot River Road from State Highway (SH) 34 east will loom significant.

The Union Pacific Railroad owns and operates almost all the trackage in southeast Idaho. The major east-west rail route in the region is a segment of the Omaha to Portland route. Scheduled daily traffic on this route includes five trains each way. Schedules are annual averages because freight is hauled when the amount warrants a run.

The major north-south route includes trackage from Salt Lake City to McCammon and from Pocatello to Butte. Scheduled daily traffic on this route includes three trains each way on the Salt Lake City-McCammon trackage and one train each way on the Pocatello-Butte trackage. The Pocatello-Butte schedule includes two trains daily during a four month period to accommodate ore hauling. In addition to the major schedules, local daily schedules include three trains each way on the Pocatello-Idaho Falls route, one train each way on the Pocatello-Green River route, and one train each way on the Pocatello-Montpelier route. General categories of commodities hauled include machinery, heavy motorized equipment, farm products, non-metallic ores, coal, lumber, chemicals, and petroleum.

Discussion of rail transportation related to phosphate is given in Part 3.

h. Motor Carrier

The most systematic way to collect information on motor carrier transportation appears to be to obtain routes and ton-mile information for common carriers in the following categories; package carriers (such as Garretts) and specialized carriers (such as Midstate Transports). Private trucking concerns were willing to provide what information they had but advised that the only reasonable way to compile a comprehensive, regional picture of motor carrier transportation would be to get data from a centralized collection source such as the Idaho Public Utilities Commission (IPUC). When information was solicited from the president of the IPUC, the Task Force were informed that the commission did not have this kind of data. If, indeed, such information is not available from the IPUC, then short of contacting every motor carrier that hauls freight in the Southeast Idaho Region, there appears to be no motor carrier data source.

i. Bus

Three buslines operate scheduled routes in the southeast Idaho region. Greyhound BusLines have three daily scheduled busses each way between Pocatello and Preston and one daily scheduled bus each way between Pocatello and Malad. All are segments of Greyhound's Pocatello to Salt Lake City schedule. There are also four daily scheduled busses each way between Pocatello and Idaho Falls.

Aberdeen Valley Stages schedules two runs daily to American Falls to accommodate Lamb Weston employees. They schedule two runs daily originateing and ending in Pocatello and includeing the towns of Blackfoot, Aberdeen, and American Falls; there is one roundtrip bus daily (except Sundays and holidays) between Pocatello and Montpelier.

Teton Stage Lines schedules one roundtrip bus daily (except Sundays and holidays) between Victor and Idaho Falls to carry passengers and packages.

j. Air

There are fourteen municipal airports (the Idaho Falls municipal airport is the only airport included outside of planning region V) and two Forest Service airports in the area. Only two are controlled be FAA operated towers: Pocatello and Idaho Falls. These are served by Hughes Air West and Western Airlines. These airports have current (1974) origin and destination counts of 141,859 and 83,628, respectively. Both airports provide direct service to Boise and Salt Lake City which in turn provides direct service to Chicago, Portland, Seattle, Spokane, Reno, Denver, and San Francisco. Air freight has been increasing at about seven percent per year for the past five years and this increase is expected to continue. The other airports are located at Rigby, Blackfoot, Downey, Preston, Paris, Montpelier, Grace, Bancroft, and Soda Springs in Idaho, and Afton and Cokeville in Wyoming. Limited air traffic also uses unpaved, private landing strips on ranches and at other locations within the area.

k. Intergovernmental Cooperation

The availablility of social services, transportation systems, water and sewage, health and educational facilities, recreational opportunities, and a variety of other governmental services are determinants of the capacity of a region to absorb economic and demographic growth. Like most substate regional areas, government policies in southeast Idaho are set by a multitude of authorities. Jurisdiction over land use, revenue raising capabilities (including taxation), and public services are shared among federal and state agencies, local general purpose governments (cities and counties), and a myriad of special district government agencies. For example, the ownership and administration of recreational picnic areas in the study area involves the U.S. Forest Service, the Bureau of Reclamation, the U.S. Corps of Engineers, the Idaho Parks and Recreation Department, the Idaho Division of Highways, city and county governments, and the private sector. The proliferation and fragmentation of governmental authorities makes even relatively simple matters complex and raises problems of coordination of policies, services and programs.

A vital factor in assessing the capacity of a region to respond to the stimulus of rapid growth is the willingness of local governmental officials to cooperate and work together for mutual advantage. A coordinated and united local impulse is better suited to stimulate response from federal agencies and authorities. Thus an important consideration is the willingness of local governments to participate in cooperative efforts to make parallel decisions and to coordinate policy.

A scale designed to assess the readiness of local governments to cooperate was developed in 1971 and applied to Idaho county governments by SICOG. Four components were measured and the results organized into an index of "political vitality", or the readiness of a county to participate in cooperative relationships with other local governments.

The measured components were: (1) resource utilization, based upon local property tax effort; (2) volume of intergovernmental linkages based upon a survey of formal and informal contacts or linkages, between county officials and other local governmental offices as well as between county officials and state and federal governmental offices; (3) public accountability,as measured by the ratio of reported market value of real property in each county to the calculated or "true" market value; and (4) level of competition among political parties in winning elective positions in county governments.

Index scores were assigned for each of the four categories, with the composite score indicating the degree of "political vitality". The nine counties receiving the highest rating based upon the scale accounted for nearly 50 percent of all intergovernmental contacts reported by all 44 counties in Idaho. Moreover, the nine counties ranking low in the political vitality index ranked low in number of intergovernmental contacts. The study concluded that while a high index score was not associated with membership in multicounty cooperative organizations, the formation and maintenance of regional cooperative efforts appears to depend upon the presence of one or more counties with a high ranking on the political vitality index.

The eight counties in the area ranked as follows: High "Political Vitality": Bingham, Bonneville; Medium "Political Vitality": Bannock, Bear Lake, Franklin, Oneida, Power; Low "Political Vitality": Caribou.

The potential for intergovernmental cooperation in the area appears high. Bingham and Bonneville Counties received the highest scores among all counties in the State. Evidence of a willingness to cooperate on common problems is seen in the Southeast Idaho Council of Governments and regional evaluation of programs involving social services and environmental considerations in the area. A factor which may inhibit cooperation is the decision of Bonneville County to limit its participation in multicounty associations, although a multijurisdictional association of governments has been formed within the county itself.

1. Health and Medical Care

Southeast Idaho lags behind the national average in medical personnel. The availability of professional services and advanced medical technical teams is generally limited to Pocatello and Idaho Falls, with medical facilities and services less technically developed in rural areas where the per capita percentage of medical doctors is lower.

The social-cultural environment of the area places a premium on family living and activities. The number of divorces in the region in 1973-74 is lower than the national average for the population base. The fertility rate of women has dropped at a rate lower than the national average and in 1973 was 7.7 percent higher than the state as a whole and 41 percent higher than that of the United States.

m. Lincoln County, Wyoming

A few workers in the phosphate industry currently live in Freedom, Wyoming, in Lincoln County, which borders the eight-county phosphate area in Idaho.

There has been a steady decline in socioeconomic activities in Lincoln County since 1940. The county's population characteristics show a general decline between 1950 and 1970 as shown in the following table:

Year	1950	1960	1970
Population	9,023	9,018	8,640

Source: U.S. Census, Characteristics of Population, Wyoming, 1960 & 1970

The period between 1960 and 1970 saw a decline of 4.2 percent. Migration from the area amounted to 18.2 percent. The population projections for the county in the future also indicate the further decline, as shown below:

Year	1980	1990	2000	2010	2020
Population	6,009	4,375	3,159	2,535	2,131

By age groups there has been a 17 percent decline of the productive labor force in the age group 25 to 44. This indicates that the general population of the county is becoming older.

In 1970, unemployment was 6.9 percent for males and 8.9 percent for females. The median income was $7,796, and 10.6 percent of the families had incomes below the poverty level.

The number of farms has continued to drop, but in 1969, the total farm acreage increased by 10,000 acres. These figures indicate an entrenchment in farming as the business and industrial segments of the economy waver. The number of farms is decreasing as they become larger and more mechanized. The importance of farming to the economy is increasing. According to the Brigham Young University, the dairy industry seems to be the most profitable and stable industry in the county. The importance of agriculture to the county will not lessen in the future, owing to increased demands for agricultural products and, consequently, increased profits to the area.

The lumber industry is another stable factor in the economy of the county. Star Studs account for 20 percent of the economic activity of the region. Combined with the dairy industry and related businesses, these two industries account for 40 percent of the economic base of the area.

Stauffer Chemical Company has a phosphate mine in Sage which employs many of the residents of Cokeville and Sage. Also, in 1960, Utah Power and Light built a large coal-burning powerplant near Kemmerer which obtains its coal from the Kemmerer mines.

At present, the county produces oil, natural gas, phosphate, agricultural products, tourist services, lumber, and railroad support. Sixty-seven percent of the land in the county is federally owned.

A stable population and business atmosphere lessens the county's need to provide increased services. The population is aging and growing smaller. The demand for new services is not growing, leaving only a necessity for the maintenance of facilities in use now. The only factor which may change the economic and social character of the area seems to be the opening of new subdivisions for second homesites. These developments may not be as successful as those in Bear Lake County, owing to the lack of a large metropolitan area close enough to draw from and the proximity of Jackson. Jackson is far enough away that people will not build in Star Valley to go skiing in Jackson, but it is close enough that it cannot develop its own recreational possibilities with a large degree of success.

The total picture for Lincoln County generally is one of a small, somewhat stable economy based on traditional jobs and with no obvious source of growth. The culture remains relatively homogeneous. No influx of people with different backgrounds has disturbed the status quo of the area. Similarly, the religion of the county is dominated by the L.D.S. Church. Future trends in cultural patterns foretell little, if any, change in these patterns.

3. TRANSPORTATION AND UTILITIES SYSTEMS

a. Transportation Networks

This section discusses the major transportation and utilities systems that serve southeastern Idaho and link it to national transportation and utilities networks. The socioeconomic aspects of the major transportation networks were discussed in the previous section.

In contrast, Part 3 deals primarily with the specific transportation and utilities networks that provide joint access, service, and ore-transport facilities for current and proposed mining operations. These networks connect the regional transportation and utilities networks discussed here with the transportation and utilities systems unique to each mining proposal covered in Parts 4 through 11.

The major Federal and State highways in and near the area are shown on map 1. Interstate I-15 runs north and south along the western edge of the area, from the Utah-Idaho border south of Malad, to Dillon, Montana. The Idaho portion of an unfinished section between Malad and Tremonton, is presently under construction.

U.S. Highway 30 from Pocatello to the Wyoming border is a two-lane intrastate truck route serving the Pacific Northwest. Both horizontal and vertical alinement are considered inadequate for present traffic between Lava Hot Springs and Alexander. In the summer of 1975 the Idaho Department of Highways let a contract for partial construction of an alternate route known as "Fish Creek Cutoff" which will shorten travel distance between Lava Hot Springs and Alexander by 11 miles. Arterial standards are planned for this alternate route. The cutoff is now under construction.

U.S. Highway 26 borders the region on the north. It parallels South Fork of the Snake River from Idaho Falls, to Alpine, Wyoming. Traffic is predominately for recreation and local use. Sections of the highway from Swan Valley to Alpine are substandard for heavy truck traffic because of excessive grades and poor alinement. Major reconstruction of a narrow two-lane section of Highway 26 from Granite Hill to Swan Valley is in the preliminary planning stage. Three alternative routes are under consideration, but construction will not begin for at least five years.

Two other Federal highways--U.S. Highway 91, which departs Interstate 15 south of McCammon and extends into northern Utah, and U.S. Highway 89, a major north-south route through western Wyoming, may receive additional use in the future if phosphate development increases.

Only one State highway will be directly affected by phosphate operations: State Highway 34 from Soda Springs, Idaho to Freedom, Wyoming. A portion of this highway from Wayan, Idaho to Freedom is also classified as Forest Highway No. 43. Five miles of Forest Highway 43 remain to be constructed, and the entire 22 miles lacks an adequate asphalt surface. Large numbers of heavy trucks cannot be accommodated because of insufficient subbase materials. Maintenance of the Forest Highway is quite difficult. Heavy snowfall and drifting require costly snow removal and the road surface breaks up each spring from frost heaving and spring traffic. Forest Highway 43 from Wayan to Freedom is kept open during the winter, primarily for mine workers living in Wyoming. The road however, is usually closed for several days each winter after heavy snowstorms.

Daily vehicle traffic use, shown in table 1-30, is based on traffic data obtained from permanent traffic counters established by the Division of Highways, Idaho Transportation Department, supplemented by spot counts and origin and destination studies.

The extensive railroad system in southeastern Idaho has Pocatello as its primary railhead. The single-track Omaha-Portland mainline enters Idaho in the southeastern corner of the State and proceeds in a northwesterly direction into the Bear Lake and Bear River valleys to Soda Springs. It then turns west, crosses a drainage divide and follows the Portneuf River to Pocatello. A single track line extending north from Salt Lake City, ties to the Omaha-Portland mainline at McCammon. In addition, a single-track line runs north from Pocatello to Butte, Montana.

With few exceptions, Union Pacific Railroad owns and maintains all trackage in Southeastern Idaho. One exception is a 21-mile spur which departs the Butte-Pocatello line midway between Pocatello and Blackfoot and extends east to the Gay mine on the Fort Hall Indian Reservation. The J. R. Simplot Company owns the spur and Union Pacific Railroad provides the maintenance.

b. Utilities Networks

Power is distributed within the phosphate area (see Map 13) by two public utilities, one municipal system and one rural electric cooperative system. Utah Power and Light and Idaho Power Co. serve the existing majority of heavy phosphate industry load, Lower Valley Power and Light serving rural residential loads and Soda Springs Municipal Electric Light and Power Dept. serving the city of Soda Springs. Pacific Power and Light transmits power across the area for use elsewhere. Power is obtained from hydroelectric and coal-, oil-, and gas-fired generating plants in Utah, Idaho, and Wyoming.

The Jim Bridger coal-fired generating plant, near Rock Springs, Wyoming, transmits power into and across the area through a 345-kV line for distribution by Idaho Power and Light. The line runs northwest from Cokeville, Wyoming to Goshen, Idaho. Pacific Power and Light plans two 345-kV powerlines, one under construction and one planned for 1976. These lines will parallel the Jim Bridger line to a point about six miles north of Montpelier and then continue west across the lower half of the area.

Both Idaho Power Company and Utah Power and Light Company provide power to the phosphate mining and processing operations in southeastern Idaho.

The Idaho Power Company's present peak-generating capability varies from 1,700 to 1,865 megawatts, depending on seasonal head fluctuations at the hydroelectric facilities. Hydroelectric generation comprises 70 percent of the 1,865 megawatt total; coal-fired generation, 27 percent; and oil and gas generation, 3 percent. Future planned total system additionas will increase Idaho Power's peak generating capability

Table 1-30.--Average daily traffic flow and road section mileage for Interstate, U.S., and State highways in the study area

Route number	Road section	Length in miles[1]	Average daily traffic flow[2]
Interstate Highway			
I 15	Malad to Arimo	25.13	2,350
I 15	Arimo to U.S. 30 intersection	6.70	3,183 ats[3]
I 15	U.S. 30 intersection to Inkom	10	5,110
I 15	Inkom to Pocatello	9	5,980
I 15	Pocatello to Blackfoot	23	7,840 ats
I 15	Blackfoot to Idaho Falls	34	6,483 ats
U.S. Highways			
U.S. 91	Preston to Downey	25.72	962 ats
U.S. 91	Downey to I 15 interchange	5	1,325 ats
U.S. 89	Fish Haven to Paris	)	1,165 ats
U.S. 89	Paris to Ovid	19)	1,530
U.S. 89	Ovid to Montpelier	)	2,080
U.S. 89	Montpelier to Geneva	16	845 ats
U.S. 30	I 15 interchange to McCammon exit	.77	2,340
U.S. 30	McCammon exit to Lava Hot Springs	)	1,870 ats
U.S. 30	Lava Hot Springs to Bancroft	37)	1,675 ats
U.S. 30	Bancroft city limits to SH 34 intersection	)	1,680
U.S. 30	SH 34 intersection to Alexander	)	2,360
U.S. 30	Alexander to Soda Springs city limits	6.12	3,020
U.S. 30	Soda Springs city limits to Georgetown city limits	27)	1,645 ats
U.S. 30	Georgetown city limits to Montpelier city limits	)	1,895 ats
U.S. 91	Pocatello city limits to I 15 interchange	24)	2,813 ats
U.S. 91	I 15 interchange to Blackfoot city limits	)	3,475 ats
U.S. 91	Blackfoot city limits to Shelley city limits	16	2,798 ats
U.S. 91	Shelley city limits to Idaho Falls city limits	7	5,330 ats
U.S. 26	Idaho Falls to Ririe	10	2,630
U.S. 26	Ririe to Swan Valley	29	1,820
U.S. 26	Swan Valley to Palisades	12	1,145 ats
U.S. 26	Palisades to Wyoming line	15.8	790 ats

Table 1-30.--Average daily traffic flow and road section mileage for Interstate, U.S., and State highways in the study area--Continued

Route number	Road section	Length in miles[1]	Average daily traffic flow[2]
State Highways			
S.H. 34	Preston to SH 36 intersection	4.55	1,350
S.H. 34	SH 36 intersection to Cleveland	15.33	665 ats
S.H. 34	Cleveland to Thatcher	5.47	615 ats
S.H. 34	Thatcher to Grace	10.68	1,120 ats
S.H. 34	Grace to U.S. 30 intersection	4.80	1,425 ats
S.H. 34	Soda Springs to Conda road	4.30	1,690 ats
S.H. 34	Conda road to Henry	13.15	415 ats
S.H. 34	Henry to Wayan	37.06	195 ats
S.H. 34	Wayan to Wyoming state line		95 ats
S.H. 36	SH 34 intersection to Ovid	34.09	480 ats

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[1] Approximate.
[2] Includes all types of vehicles on a specified section.
[3] Average traffic flow for the total road section.

Source of data: Idaho Department of Highways.

to 2032 megawatts by 1983. This additional capability would be supplied by 167 megawatts the fourth unit of the Jim Bridger plant also reconstruction of the American Falls Dam and improvements on the Brownlee Dam generating units. Soda Springs Municipal System purchases three-quarters of its power from Utah Power and Light. Additional capacities for Soda Springs Municipal Electric Light & Power are included in Utah Power and Lights additional future capacity. Lower Valley Power and Light purchases power from Bonneville Power Administration and is not addressed as part of this impact statement.

The present peak generating capability of the Utah Power and Light system totals 1,768 megawatts. Coal-fired generating capability comprises 88 percent of this total; oil and gas generation, 3.2 percent; and hydroelectric generation, 8.8 percent. The company plans to increase its generating capability to 2,968 megawatts by the spring of 1980 by adding the 400 megawatt Huntington second unit in the spring of 1977, the first 400 megawatt unit of the Emery coal-fired generating plant (located in central Utah) in the spring of 1978, and the 400 megawatt Emery number 2 unit in the spring of 1980.

These future expansions in generating capability planned by both utilities cannot be constructed unless approved by the appropriate public utility commission of Idaho or Utah and Wyoming.

The phosphate mining and processing-related loads in southeastern Idaho served by these two utilities totals approximately 460 megawatts. Idaho Power supplies roughly two-thirds of the energy and Utah Power and Light, the remaining one-third. Utah Power and Light is presently negotiating with Idaho Power to take over all of the Monsanto load. If this occurs, Utah Power and Light would supply approximately 41 percent and Idaho Power, 59 percent of the total power. The FMC's elemental phosphorus plant near Pocatello and the Monsanto Company's elemental phosphorus plant near Soda Springs comprise 86 percent of the load.

Presently about 870,000 tons of raw ore are annually shipped by train out of southeastern Idaho by Stauffer Chemical Company. Four hundred and twenty thousand tons are processed at the elemental phosphorus plant in Silver Bow, Montana, and 500,000 tons are processed at the phosphate fertilizer plant in Leefe, Wyoming. Processing this ore requires an electrical load of approximately 65 megawatts at Silver Bow and 7 at Leefe.

Major power failures are rare, but icing conditions have caused severe damage to older lines, poles, and towers. Old powerlines are being replaced or reinforced as necessary. Lighting and overloads contribute to minor power failures.

Northwest Pipeline Corporation supplies all the natural gas available within the immediate and adjacent area. A pipeline, located in the south third of the area, enters Idaho east of Bear Lake and continues northwest through Montpelier and Soda Springs, and then west through McCammon and Pocatello. Northwest Pipeline Corporation has stated that the line is adequate for present use and that construction of new lines is not planned.

Chevron Pipeline Company operates and maintains an 8-inch finished petroleum products pipeline. The pipeline originates as a spur line at Idahome Junction and terminates at Pocatello, Idaho. This line is entirely outside the region but is a vital petroleum-products supply line. No future expansion or extensions are anticipated.

No major aqueduct systems or surface waters are used for commercial transportation in the area. Transportation by water is not feasible in the area. Several water transmission projects, however, either exist or are planned. The Georgetown watershed project, in Georgetown Canyon is presently under construction. The project will irrigate 2,950 acres of high erosive flood-irrigated land and 550 acres of dry farm land under a gravity sprinkler irrigation system. System capacity will be 43 cubic feet per second. Project cost is estimated at about $2.7 million. Irrigated water will be carried through 14.7 miles of steel pipeline ranging from 38 inches at the settling basin to 4 inches at each distribution point. The 20- by 50-foot concrete settling basin has been constructed in Georgetown Creek. Sediment retained in the basin will be periodically flushed back into the creek through a 15-inch gate or hauled away by truck.

Some irrigation water is distributed through large canals (8 to 12 feet-canal bottoms) in the area. Utah Power and Light Company controls water flows between the Bear River and Bear Lake through a large canal as needed for power and irrigation. Lake levels fluctuate as much as 21 feet during an average year.

Fourteen airports are in or adjacent to the area. These are not used to any significant extent by the present phosphate industry, except in normal commercial air travel, as discussed in the section on socioeconomics.

4. RECREATION RESOURCES

There is so little urbanization and development in the study area that practically the entire area is available for outdoor recreation. The area includes both land- and water-based outdoor recreation resources and makes up 9 percent of the State's total outdoor recreation acreage. This inventory of outdoor recreation acreage includes lands under ownership or administration of Federal agencies, State Agencies Inventory of Public Lands, Parks and Recreation, Highways and Historic Society, Fish and Game (streams and lakes) and recreation facilities of counties, municipalities and the private sector. A summary of State, local, and private resources is given in table 1-31. Outdoor recreation resources and facilities approved for Land and Water Conservation funds by the Bureau of Outdoor Recreation are shown in table 1-32. These total $1.9 million.

Outdoor recreation resources in the study area, their proximity to other destination use sites, and the standard of existing facil-

Table 1-31.-- Existing outdoor recreation resources and facilities in the study area. 1/

Recreation areas and facilities	State agencies	Local government agencies	Private Sector
Land acres	20,640	2,173	--
No. of recreation areas	--	--	1,475
Playfield acres	--	382	15.1
Camping sites	51	99	291
Camping acres	--	32	--
Picnic sites	16	--	--
Picnic acres	--	289	--
Holes of golf	--	99	36
Swimming pools (sq. ft.)	--	218	1,010
Swimming beaches (acres)	--	8	--
Snow ski acres	--	--	281
Boat access ramps	8	13	--
Boat access slips	2	1	2
Hiking trails (miles	--	1	--
Horse trails	--	1	--
Horse riding (acres)	--	--	167
Horses	--	--	50

[1] Bannock, Bear Lake, Bingham, Bonneville, and Caribou Counties.

Source: Idaho Outdoor Recreation, 1973; Idaho Department of Parks and Recreation.

Table 1-32.--Outdoor recreation resources and facilities approved under the Land and Water Conservation Fund Act of 1965[1]

Name of Project	Location
Pocatello Zoological Gardens	City of Pocatello
Hawthorne Park	City of Pocatello
Indian Rocks State Park	Department of Parks
Stuart Park	City of Chubbuck
Lava Hot Springs Foundation Dev.	Lava Hot Springs
Inkom Park Improvements	City of Inkom
Pocatello Parks	City of Pocatello
McCammon City Park	City of McCammon
Paris City Park	City of Paris
Blackfoot Park	City of Blackfoot
Presto Park	Bingham County
Blackfoot Swimming Pool	City of Blackfoot
Shelley Swimming Pool	City of Shelley
Blackfoot Tennis Court	Blackfoot School Dist. #55
Jensen Grove Park	City of Lewiston
Aberdeen Sportsman Park	Bingham County
Indian Creek Recreation Area	Department of Parks
McCowin Park	City of Ammon
Eagle Rock Park	City of Idaho Falls
McCowin Park & Recreation Area	City of Ammon
Skyline Tennis Courts & Rec. Area	City of Idaho Falls
Ucon City Park	Town of Ucon
Child Development Playground	Child Development Center
Tautphaus Park	Dept. of Parks & Rec.
Sand Creek Golf Course	City of Idaho Falls
East Tautphaus Park	City of Idaho Falls
Clair E. Gale Recreation Area	City of Idaho Falls
Snake River Park	City of Idaho Falls
West Side Recreation Complex	Idaho Falls School District #91
Ammon City Park - Acq.	City of Ammon
Hooper Springs Park	City of Soda Springs
Caribou County Park	Caribou County
Grace City Park	City of Grace
Soda Springs Geyser Park	City of Soda Springs
Freedom Park Development	Caribou County

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[1] Bannock, Bear Lake, Bingham, Bonneville, and Caribou Counties.
Source: Bureau of Outdoor Recreation

ities limit outdoor recreation uses generally to local and near-local recreation demands. An exception to this is a small fraction of domestic and foreign travelers who come into the area for the high quality of fishing and hunting experiences.

As surrounding areas, such as Yellowstone and Teton National Parks, Island Park, and other high-density outdoor recreation areas become more crowded, congested, and overused, outdoor recreation uses within the study area will likely increase in importance. Quality water-based outdoor recreation resources, such as the Palisades, Blackfoot River, and American Falls Reservoirs and Bear Lake, will probably become significantly more important outdoor recreation attractions in the future.

The quality and type of outdoor recreation opportunities and experiences are primarily controlled by the topography and its related components of climate, soil, water, landscape, vegetation, and wildlife. The temperature in the study area has the greatest range extremes in the State; the land is high and has scenic rugged mountains with large amounts of foothills. The area offers quality natural recreation resources with features and areas to meet the requirements of all classifications of outdoor recreation. These include high density, general outdoor, natural environment, outstanding natural and primitive areas, and historic and cultural sites.

Numerous reservoirs, lakes, streams, creeks, and rivers in the area provide excellent recreation opportunities for fishing, boating, swimming, and water skiing. Some of the more important of these are the American Falls, Blackfoot River, and Palisades Reservoirs and Bear Lake. The numerous mountain streams, creeks, and several rivers that provide quality outdoor recreation opportunities have been discussed in the aquatic environment and fisheries section.

While the area's water resources offer quality recreation opportunities, there is a general lack of recreation facilities throughout the area, which reduces the enhancement and enjoyment of water-based outdoor recreation resources.

Bear Lake deserves special consideration because of its size and potential. It consists of 70,500 acres astride the Idaho-Utah State line. Much of the shoreline is privately owned; however, two State parks and several local parks provide recreation opportunities along its shores. The lake provides good fishing for rainbow, cutthroat, and mackinaw trout, perch, white fish, and Bonneville Cisco, a species unique to Bear Lake. A rapidly increasing number of summer homes and increased demands for outdoor recreation opportunities on Bear Lake are causing the organic nutrient content to increase, which in turn causes accelerated aging. This is becoming further complicated in Bear Lake since it is operated as a storage reservoir.

The Bear Lake National Wildlife Refuge, also known as Mud Lake and Dingle Swamp, includes 17,573 acres of marsh, open water, and grasslands. It is located north and adjacent to Bear Lake at an elevation of 6,000 feet. Dingle Swamp, a marsh within the refuge, is a major production area for western Canada geese. Waterfowl hatched here are harvested in most Pacific flyway States south of Idaho. Recreation opportunities are currently limited mostly to sightseeing, nature study, photography, and passive recreation uses. Hunting, fishing, and other quality recreation opportunities will become available in the future when the National Wildlife Refuge long-range improvement plan and programs are completed; these include improving vegetation and habitat for wildlife and fish.

The Grays Lake National Wildlife Refuge contains 16,718 acres, but proposed additions in an ongoing acquisition program could enlarge the refuge to 32,600 acres on completion. At an elevation of 6,385 feet, it has short summer seasons. It is basically a shallow-flooded bulrush marsh where annual water management is handled by the Bureau of Indian Affairs. The lake refuge produces about 1,000 Great Basin Canadian geese and 8,000 ducks annually. It is located in Bonneville County, 26 miles north of Soda Springs. The refuge provides quality nature-oriented recreation including public hunting. Grays Lake has one of the largest greater sandhill crane production populations in the country. Significant lakes and reservoirs in southeastern Idaho are listed in table 1-33.

There are more than 936,000 acres of National Forest land within the study area, including portions of the Caribou National Forest. This land provides outstanding and highly diverse outdoor recreation opportunities. They include identified natural roadless areas for primitive recreation opportunities, semi-primitive areas where all terrain and off-road vehicles hunting, fishing, and rock-hounding are of primary importance, and passive recreation use areas which lend themselves to activities as vehicle camping, picnicking, driving for pleasure, boating, and hiking. Nine roadless areas covering 130,720 acres have been inventoried in the Caribou National Forest within the phosphate study area. These areas provide important primitive and semiprimitive recreation opportunities such as hiking, horseback riding, and hunting. Several of these identified roadless areas lie adjacent to or in close proximity to existing and proposed mining areas. These include the following:

1) Worm Creek area, (9,000 acres), located approximately 2 miles SW of the proposed Paris Bloomington Mine.

2) Snowdrift Mt. - Crow Creek area, (17,920 acres), located adjacent to and just East of Georgetown Canyon mine.

3) Huckleberry Basin area, (18,500 acres), located just east of the proposed Middle Sulphur Canyon mine, North and east of the proposed Swan Lake Gulch mine and approximately 2 miles south of the proposed Trail Creek mine.

4) Bear Creek area, (32,000 acres), located west of Palisades reservoir.

5) Diamond Peak area, (38,500 acres), located just North and East of the proposed Diamond Creek mine.

Table 1-33.--Reservoir and Lakes in Southeastern Idaho

Reservoirs	Location and Size	Type of Fish	Facilities
American Falls	Bingham & Power Counties 50,000 acres	Rainbow trout, crappie & perch	Boat dock & ramp
Alexander	Caribou County 1,165 acres	Rainbow & cutthroat trout, perch	Boat ramp & picnic tables
Bear Lake	Bear Lake County 120 sq. miles	Rainbow & cutthroat trout, mackinaw, perch & cisco	Docks & picnic tables
Blackfoot	Caribou County 19,000 acres	Rainbow & cutthroat trout	Campground, boat ramps
Bloomington	Bear Lake County 10 acres	Rainbow & cutthroat trout	Campground
Chesterfield	Caribou County 1,590 acres	Rainbow & cutthroat trout	Boat launching & parking
Condie	Franklin County	Bass, bluegills & rainbow trout	Boat launching & parking
Crowther	Oneida County 35 acres	Rainbow trout	Boating by private owner
Daniels	Oneida County 475 acres	Rainbow & cutthroat trout	Boat ramp, docks & sanitary facilities
Deep Creek	Oneida County 160 acres	Rainbow & cutthroat trout	Boat ramps & public parking
Devils Creek	Oneida County 140 acres	Rainbow & cutthroat trout	Boat Ramps, docks, toilets, picnic area
Dike Lake	Caribou County 35 acres	Rainbow trout	Parking & sanitary facilities
Foster	Franklin County 115 acres	Rainbow trout	No facilities
Glendale	Franklin County 232 acres	Rainbow trout	Ramp, floating dock, toilets, picnic area
Hawkins	Bannock County 30 acres	Rainbow trout	Boat launching, no other facilities
Johnson	Franklin County 40 acres	Rainbow trout, perch & bass	Parking & picnic area
Lamont	Franklin County 87 acres	Rainbow trout	Ramp, floating dock & parking

Table 1-33.--Reservoir and Lakes in Southeastern Idaho, continued

Reservoirs	Location and Size	Type of Fish	Facilities
Montpelier	Bear Lake County 125 acres	Rainbow & cutthroat trout	No facilities
Nash	Franklin County 30 acres	Bass & perch	No facilities
Oneida	Franklin County 480 acres	Rainbow & cutthroat trout	Parking & dock
Oxford	Franklin County 15 acres	Large-mouth bass	No facilities
Palisades	Bonneville County 20 mi. X 2 mi.	Cutthroat, brown & mackinaw trout	4 USFS campgrounds, boat ramps, cabins, good facilities
Pleasant View	Oneida County 32 acres	Rainbow trout	No facilities
St. John	Oneida County 35 acres	Rainbow trout	No facilities
Samaria	Oneida County 10 acres	Bass	No public acess
Springfield	Bingham County 66 acres	Rainbow trout	Boat ramp & parking
Stone	Oneida County 250 acres	Crappie, rainbow & bass	USFS campground, boat ramp
Tresureton	Franklin County 156 acres	Rainbow trout	Ramp & parking area
Twenty-Four Mile	Caribou 900 acres	Rainbow trout	Parking only, no other facilities
Twin Lakes	Franklin County 500 acres	Bass, bluegill, rainbow, brook & cutthroat trout	Parking, ramps, docks, tables & toilets
Weston	Oneida County 112 acres	Bass, perch & rainbow trout	No facilities
Winder	Franklin County 85 acres	Rainbow trout	No facilities
Wiregrass	Bannock County 30 acres	Rainbow trout	No facilities

Source: U. S. Fish and Wildlife Service

A wide variety of general outdoor recreation areas are also abundant within the forest. These areas include resorts, scout camps, archery ranges, reservoirs, and lakes. A number of unique features are located within the forest boundaries, including two ghost towns, an old halfway house stage stop, outstanding fossil beds, berrypicking sites, an ice cave, and a number of limestone caves including the Minnetonka Cave in the Caribou National Forest. This cave is open to the public with guided tours on a seasonal basis.

There are other limited Federal land holdings in the area. The Bureau of Land Management manages about 160,500 acres of land in the area with mostly undeveloped recreation resources, and the U.S. Fish and Wildlife Service manages the two National Wildlife Refuges previously described.

The Idaho State Department of Parks and Recreation operates two State parks in the Bear Lake vicinity and one near McCammon-Pocatello. On Bear Lake, the North Beach State Park is located 6 miles east of St. Charles on the Idaho side of the lake. Facilities include a boat ramp, comfort stations, and parallel parking to accommodate 400 vehicles. The primary attraction is its 1¼-mile-long swimming beach.

On the east side of Bear Lake, the State operates the Eastside Park. It contains approximately 914 acres of outdoor recreation area with almost two miles of shoreline but it has limited facilities.

The Indian Rocks State Park near McCammon is operated in cooperation with Idaho State University in Pocatello. It includes an office/information center and a 50-unit campground with 20 units having water and electrical hookups, modern restrooms, and bathing facilities.

Lava Hot Springs is a self-supporting State recreation area and is operated as a foundation. This recreation complex had nearly 200,000 paid admissions in 1974 and provides quality recreation experiences; natural mineral springs provide hot water to large and small swimming pools for year-round use. Other facilities include picnic areas, diving and sliding platforms, playground, park, and hiking and sunbathing areas. Located nearby are two private golf courses, horse stables, ski areas, and hunting and fishing to complement the Lava Hot Springs recreation resources. Private enterprise efforts have enabled Idaho State to realize tourism as its fourth largest industry.

The Idaho Department of Fish and Game administers 41,528 acres of land in the area. These holdings consist of game range, fish hatcheries, public access to roads, trails, boat ramps, and sanitation stations for hunting, fishing, and outdoor-recreation purposes. Much of the land is under cooperative agreement management programs with the counties in which they are located or with other State agencies. These include the following:

Name of Project	County	Acreage
Bear Lake Canal Outlet	Bear Lake	200 (Dingle Swamp)
Montpelier Game Range	Bear Lake	491
Montpelier Game Range, Access Route and Canal Crossing	Bear Lake	777
Bear Lake Access North Beach Jetty	Bear Lake	-
Danielson Lake Public Access	Bingham	10
Snake River Access Ferry Butte Segment	Bingham	3.7
Ferry Butte Addition	Bingham	1.2
Willow Creek Access	Bingham	178
Snake River Access Pingree Segment	Bingham	5.9
Snake River Access Riverton Site	Bingham	1.2
Gem State Power Site, Snake River	Bingham	23
Blackfoot River Access	Bingham	160
Snake River Islands Firth Segment	Bingham	487
Supplement #1 Firth	Bingham	118
Snake River Islands, Blackfoot	Bingham	625
Blackfoot Reservoir Access Poison Creek	Bingham	1
Snake River Islands, Blackfoot	Bingham	59
Sterling Wetlands	Bingham	1241
East Butte	Bingham	Radio Repeater Site
Upper Snake Regional Office	Bonneville	.7
Upper Snake Addition #1	Bonneville	.9
Upper Snake Addition #2	Bonneville	.3
Grays Lake Access	Bonneville	11
Gem State Power Site, Snake River	Bonneville	27
Irwin	Bonneville	15
Conant Valley	Bonneville	17
Grace Hatchery, Whiskey Creek	Caribou	17
Grace Hatchery Addition	Caribou	1.4
Blackfoot River Sucker Trap	Caribou	5
Soda Point Public Access	Caribou	45
Road Right-of-way, Whiskey Creek Hatchery	Caribou	1.3
Road Right-of-way	Caribou	.4
Black Canyon of Bear River Cove Power Plant	Caribou	.3
Blackfoot Reservoir	Caribou	5
Blackfoot Reservoir Craig Lake	Caribou	Right-of-way
Blackfoot Reservoir Hopkins Landing	Caribou	Sanitary Stations
Dike Access	Caribou	Sanitary Station
Blackfoot Reservoir Access	Caribou	Coop Agreement

Source: Idaho Fish and Game Department

The route of the historic Oregon Trail crosses the area. Potentials of the route for public recreation are described in the draft report of a cooperative study directed by the National Trails System Act (P.L. 90-543). The portion of the route in the area is generally unknown to the public, and its potentials for recreation are largely unrealized.

Two Oregon Trail segments in the study area have high potential for public use. Both traverse relatively natural appearing, hilly, scenic rangeland which supports native sagebrush-grass vegetation. Both afford sweeping views of the surrounding hills and timbered mountains, and extensive Oregon Trail wagon ruts are still visible along each segment. The West Thomas Fork segment (2 miles) has potential for scenic interpretive trails, and the Big Hill segment (5 miles) could be developed as an interpretive drive over low-standard, back-country roads. In addition, 15 historic sites related to the Oregon Trail are located in the area, some of which have potential for interpretive development.

Portions of the Oregon Trail route in the study area, particularly the two high-potential segments, and some of the historic sites probably are eligible for nomination to the National Register of Historic Places. Executive Order 11593 and the National Historic Preservation Act of 1966 apply to eligible sites and segments of the Oregon Trail.

Portions of the historic Lander Road are still visible, and the terrain through which it passes is scenic. The old wagon road is of interest to both recreationists and historians. Portions of it are away from roads and have potential for establishment as interpretive trails. The Forest Service and the Bureau of Land Management have jointly produced a brochure-type guide, with a detailed map showing both the Lander Road and a motor route which follows the historic route as closely as posible on existing roads. Visible remnants of the Lander Road and historic sites along it may be eligible for nomination to the National Register of Historic Places. Executive Order 11593 and the National Historic Preservation Act of 1966 apply to there eligible areas.

Since 1965, the Bureau of Outdoor Recreation has provided $1.9 million on a matched basis to the Idaho Department of Parks and Recreation for acquisition and development of outdoor recreation resources and facilities in the area. Before 1965, many communities set aside land for park use, but these were largely undeveloped owing due to lack of funds.

Recent trends in outdoor recreation activities show almost a 10 percent annual increase in snowmobiling, motorcycling, and diverse camping activities in the National forest. Other outdoor recreation activities increased on an average of 5 percent. It is anticipated that the demand for outdoor recreation activities will increase at a much faster rate than will population. Projected outdoor recreation demands are shown in tables 1-34 and 1-35.

Table 1-34 .--Current and projected total outdoor recreation demand[1]

Land based activities	Demand in activity days in 1,000's 1975	1980	2000
Bicycling	4,221	4,639	7,464
Pleasure driving	2,055	2,273	3,657
Playing outdoor games & sports	1,797	1,982	3,190
Hiking & walking	1,495	1,647	2,650
Camping	1,079	1,193	1,919
Picnicking	1,040	1,145	1,842
Viewing outdoor sporting events	757	1,054	1,695
Motorcycling	629	691	1,112
Golfing	587	644	1,036
Hunting	456	501	806
Skiing	391	429	691
Photography	286	315	506
Horseback riding	215	237	381
Sledding & ice skating	207	227	365
Rockhounding	137	150	241
Snowmobiling	99	108	174
Other	356	391	629
Water based activities			
Swimming	2,417	2,664	4,468
Fishing	1,357	1,494	2,404
Boating & water skiing	832	1,013	1,630

[1] Bannock, Bear Lake, Bingham, Bonneville, and Caribou Counties.

Table 1-35.--Current and projected demands for recreation facilities and areas in the study area[1]

Activity	Unit	1975	1980	2000
Bicycling	miles	153	168	271
Playing outdoor games & sports	acres	278	306	493
Hiking & walking	miles	407	448	720
Camping	acres	978	1,080	1,739
Camping	sites	5,866	6,481	10,438
Picnicking	acres	236	260	418
Picnicking	sites	2,828	3,113	5,008
Golfing	acres	3,544	3,885	6,253
Golfing	holes	355	389	626
Skiing	acres	310	341	548
Swimming	acres	31	34	56
Swimming	units	26,270	28,956	48,564
Fishing	acres	94,912	104,485	168,124
Boating & water skiing	acres	24,117	29,358	47,237

[1] Bannock, Bear Lake, Bingham, Bonneville, and Caribou Counties.

Source: Idaho Outdoor Recreation, 1973; Idaho Department of Parks and Recreation.

Between 1974 and 1976 the Idaho State Department of Parks & Recreation did a park assessment for the urban centers of Chubbuck, Shelly, Aberdeen, Ammon, Idaho Falls, American Falls, Blackfoot, Soda Springs, Preston, Montpelier, Malad and Pocatello. It was found that by the year 1980 these population centers would need approximately 32 neighborhood and 16 community parks. By the year 2000, the projected needs are 67 neighborhood parks, 34 community parks and one regional park.

These figures indicate that the communities are presently deficient in recreation facilities and would even fall further behind with the influx of population to the urban center brought about by phosphate development. This study is summarized in tables 1-35 a, b, and c.

5. ARCHEOLOGIC AND HISTORIC VALUES

Cultural resources in the study area include the sites, structures, objects, and districts that have archeological, historical, and/or architectural significance. Such cultural resources are limited and non-renewable, and they require protection and preservation.

In the early 1800's, southeast Idaho was an area of extensive travel. The major trail connecting the United States to the Pacific Coast traversed the area, as did many of its heavily-traveled cut-offs. In addition to these immigrant roads, there is evidence of an extensive fur trade and thus a network of trappers' trails which existed before the great westward movement of homesteaders and gold miners.

The area of exploration and fur trade in southeast Idaho dates between 1812 and 1860, the later date beginning the period of colonization and mining and 1812 marking southeast Idaho's participation in the fur trading businesses of Britain and the United States. Records indicate several identified early routes in the area. One route in 1812 ran from the Snake River roughly up the Portneuf River, across a divide, thence to the Bear River near Soda Springs, and then up the Bear River. Indeed, routes from the Snake to the Bear River were traversed by many of the early trappers and explorers.

In the late 1830's, settlers were heading for the Oregon Territory along the Oregon Trail through southeast Idaho (map 10). By 1843, the great westward movement along the Trail had begun. The Oregon Trail entered Idaho near Border, Wyoming, followed the Bear River until it reached Soda Springs, and then crossed over to the Portneuf River and Fort Hall.

The Oregon Trail and its cutoffs, the Lander are Sublette, and the California Trail brought thousands of immigrant wagons through the area each year. The Lander Cutoff diverged from the Oregon Trail near South Pass, Wyoming, and traveled northwest, reaching Idaho near present-day Stump, Idaho. This trail then passed the Oneida Salt Works, the first mining industry in this area, up to Gray's Lake, over to Blackfoot River, and on to Fort Hall, where it rejoined the Oregon Trail. This

TABLE 1-35a. - Summary of neighborhood park needs

LOCAL ASSESSMENT UNITS	1980 DEMAND	1980 SUPPLY	1980 NEEDS	2000 DEMAND	2000 SUPPLY	2000 NEEDS
CHUBBUCK	3 (2)	1	2 (1)	4	1	3
POCATELLO	28(19)	14	14 (5)	40	14	26
*MONTPELIER	2 (1)	1	1 (0)	2	1	1
*BLACKFOOT	4 (3)	2	2 (1)	6	2	4
*SHELLEY	3 (3)	2	1 (1)	3	2	1
ABERDEEN	2 (2)	1	1 (1)	2	1	1
AMMON	4 (2)	1	3 (1)	7	1	6
*IDAHO FALLS	20(19)	14	6 (5)	35	14	21
*SODA SPRINGS	2 (2)	1	1 (1)	4	1	3
PRESTON	3 (3)	2	1 (1)	3	2	1
MALAD CITY	1 (1)	2	0 (0)	1	2	0
AMERICAN FALLS	2 (2)	4	0 (0)	3	4	0
AREA TOTAL	74(59)	45	32(17)	110	45	67

* Communities located within study area which will be directly affected. Other communities identified will receive lesser and be indirectly effected.

TABLE 1-35b. - Summary of community park needs

LOCAL ASSESSMENT UNITS	1980 DEMAND	1980 SUPPLY	1980 NEEDS	2000 DEMAND	2000 SUPPLY	2000 NEEDS
CHUBBUCK	1 (1)	0	1(1)	2	0	2
POCATELLO	14(10)	6	8(4)	20	6	14
MONTPELIER	0 (0)	1	0(0)	1	1	0
BLACKFOOT	2 (2)	1	1(1)	3	1	2
SHELLEY	1 (1)	1	0(0)	1	1	0
ABERDEEN	0 (0)	0	0(0)	0	0	0
AMMON	2 (1)	1	1(0)	3	1	2
IDAHO FALLS	10 (9)	6	4(3)	17	6	11
SODA SPRINGS	1 (0)	0	1(0)	2	0	2
PRESTON	1 (1)	1	0(0)	1	1	0
MALAD CITY	0 (0)	0	0(0)	0	0	0
AMERICAN FALLS	0 (0)	1	0(0)	1	0	1
AREA TOTAL	32(25)	17	16(9)	51	17	34

TABLE 1-35c. - Summary of regional park needs

LOCAL ASSESSMENT UNITS	1980 DEMAND	1980 SUPPLY	1980 NEEDS	2000 DEMAND	2000 SUPPLY	2000 NEEDS
CHUBBUCK	0(0)	0	0(0)	0	0	0
POCATELLO	1(1)	1	0(0)	2	1	1
MONTPELIER	0(0)	0	0(0)	0	0	0
BLACKFOOT	0(0)	0	0(0)	0	0	0
SHELLEY	0(0)	0	0(0)	0	0	0
ABERDEEN	0(0)	0	0(0)	0	0	0
AMMON	0(0)	0	0(0)	0	0	0
IDAHO FALLS	1(0)	1	0(0)	1	1	0
SODA SPRINGS	0(0)	0	0(0)	0	0	0
PRESTON	0(0)	0	0(0)	0	0	0
MALAD CITY	0(0)	0	0(0)	0	0	0
AMERICAN FALLS	0(0)	0	0(0)	0	0	0
AREA TOTAL	2(2)	2	0(0)	3	2	1

cutoff was used by people heading for the Montana mines, as well as by immigrant families. Sublette Cutoff left the Oregon Trail at Alexander, crossed over the Fish Creek divide, and meandered in a westerly direction past Lava Hot Springs, rejoining the Oregon Trail at Raft River. The Hudspeth Cutoff left the Oregon Trail near Alexander, crossed the California Trail near Malta, and rejoined the Oregon Trail near Murtaugh. Another minor route was the Crow Creek Trail, a freight road connecting the rail head of Montpelier, Idaho to Star Valley, Wyoming. Points of interest along this trail are Sampson's Tree, White Dugway, and the Halfway House.

By 1860, permanent settlements (mainly by Mormon families) were underway and within twenty years the whole Bear River valley had been settled. Another attraction to the area was the discovery of gold in 1869 on Caribou Mountain. The boomtowns of Caribou City and Keenen City sprang up almost overnight. With the new gold mining industry, many roads and trails were built coming and going from Caribou Mountain.

Obviously, a significant aspect of America's heritage is based in southeast Idaho. Even during the fur trade era many routes were through the study area, especially the Bear River Valley, Soda Springs (which was a favorite rest spot for travelers and fur traders), and the Portneuf and Blackfoot Valleys, were an important part of cross-country travel. No systematic study has been made of the immigrant and fur traders' trails and campsites, and only systematic study in the entire area was an archeological survey of the Blackfoot Reservoir completed only recently.

Southeastern Idaho is part of a large ethnographic culture area known as the Great Basin, which includes all native Indian people of southern Idaho. Long before the early historic period of the early 1800's, these inhabitants of southeastern Idaho were hunters and gatherers. They hunted the big game--bison, elk and mountain sheep--but they also collected camas, wild tobacco, roots, and wild seeds in season. The resultant seasonal trek in search for food does not allow for the large accumulation of artifacts at any one location. Thus, the archeology of the area cannot be considered "classical" in the sense of uncovering large accumulations of "exotic" artifacts or large architectural structures such as those at sites of long, continuous occupation. The archeological sites of southeastern Idaho are, characteristically, relatively small and of limited occupation, though some sites may have been perennially or seasonally used for a number of years. However, the information accumulated from these small sites collectively results in significant understanding of aboriginal cultures, prehistoric environments, flora and fauna populations, and other areas of archeologic importance.

Thus far, only a comparatively small amount of archeological research has been done in the study area. The archeological surveys in the area have been carried out independently of each other through such unrelated projects as:

River Basin Surveys--Ririe Reservoir Project
Burns Creek Reservoir Project

Blackfoot Reservoir Project

Jim Bridger Powerline Project

Phosphate Unit Archeological Reconnaissance of Caribou National Forest

The archeological research done thus far in the study area has revealed 92 aboriginal sites: 15 in Bear Lake County, 3 in Bingham County, 18 in Bonneville County and 56 in Caribou County (map 10). Also shown on the map are historic sites designated by the Idaho State Historical Society; these are listed in table 1-36. None of these are on the proposed minesites.

In summary, very little systematic survey and appraisal has been made of the cultural resources in the study area. Historic sources and the modest number of archeologic surveys indicate considerable potential in the area.

Because of a lack of any systematic surveys in southeastern Idaho, this area is relatively unknown archeologically or historically; as a result, it is difficult to pinpoint any specific cultural resource that will be directly destroyed or damaged. By the process of inference, however, it is possible to deduct that certain sites undoubtedly do exist in the phosphate-mining region because of their known existence in other regions of southeastern Idaho. One such type of site is the petroglyph complex. There are a great many petroglyph fields near Pocatello, on the Blackfoot and Portneuf Rivers, and in the Marsh Creek area. Because of the popularity of the Bear River Valley and the surrounding areas in aboriginal as well as historic times, petroglyph complexes undoubtedly exist in the area.

Besides petroglyph complexes, there are most likely a great many open sites and rockshelters. These sites are unknown, only because there has been no opportunity to conduct research in this area. Most of the resources which have been nominated to the National Register are architectural; very few pertain to archeologic or historic sites.

6. AESTHETIC VALUES

The study area comprises mountains, foothills, mountain valleys, and river plain lands that are accented by occasional rock formations and a variety of vegetative types. Rugged mountains or wild scenic rivers are not found within the area, but the existing aesthetic values do provide an important scenic resource. The most common landform in the area is the foothills. Manmade intrusions within the area are rather disbursed but nevertheless have a significant impact, (both favorable and unfavorable) on the aesthetic environment.

Table 1-36.--Historic sites designated by the Idaho State Historical Society

BONNEVILLE COUNTY

Caribou Mountain
  Gold rush in 1869

Caribou City--on Caribou Mountain
  19th century mining town, now ghost town

Keenan City--on Caribou Mountain
  Deserted mining town founded in 1870
  (on print-out sheets is under Caribou County, although it is in Bonneville County according to map)

BEAR LAKE COUNTY

Paris
  Bear Lake County Courthouse
  Auditorium - Theater
  Latter-day Saints Stake Office, Main Street
  Tabernacle (L.D.S.)

Beckworth's Battleground--north end of Bear Lake

Ovid
  former L.D.S. Church

Georgetown
  Georgetown School
  Old Georgetown School

Saint Charles
  Gutzon Borglum birthplace (March 25, 1867)

Fish Haven
  House

Montpelier
  Josephine Driver house (has been destroyed)

Smith's Fort--Dingle vicinity, 1848

Thomas Fork--Wyoming border

CARIBOU COUNTY

Alexander--west of Soda Springs--founded in 1880 as power company town

Bancroft
  Brick house

Table 1-36.--Historic sites designated by the Idaho State Historical Society--Continued

CARIBOU COUNTY--Continued

Soda Springs (city)
  Camp Connor--1863
  Caribou County Courthouse
  Enders Hotel
  City Hall and Fire Station
  Grain elevators
  Presbyterian Church

Sheep Rock (Soda Point)--west of Soda Springs

Hudspeth Junction

Soda Springs

Mountainous areas exhibit the highest quality scenic variety and greatest vegetative contrasts. Aspen-fir and open areas of grass and shrubs provide an assortment of seasonal colors, textures, and form contrasts. Exposed rock formations exhibit a wide color spectrum but primarily the soft gray colors of the limestone formations. Elevations range as high as 9,953 feet at Meade Peak.

The Caribou, Webster, Preuss, and Aspen Ranges are parallel, running in a somewhat north-south direction in the eastern portion of the study area. The Caribou Range has the most relief and extends from near the northern end of the study area to a point halfway down the eastern boundary. Originating near Soda Springs and extending southward into Utah is the Wasatch Range.

The foothills occupy a major portion of the area (fig. 1-32a). They extend from the northern boundary, south through the central portion of the area to Soda Springs, and north and east of Bear Lake. The Blackfoot Mountains frame the eastern edge of the upper Snake River Valley. The Chesterfield Range is southwest of Blackfoot River Reservoir. Natural topography created by the drainage patterns, streams, and water bodies lends variety to the landscape. Associated with this landform in different densities and arrangements are the conifer-aspen, mountain-brush, and sagebrush-grass vegetative types. Significant visual qualities are provided by the seasonal colors and textures of the vegetation.

The several mountain ranges are separated by narrow to wide valleys that terminate in flat to undulating plateaus (fig. 1-32b). Although these valleys offer little variety themselves, they do add contrast and character to the rolling hills and mountains in presenting an overall theme of the open western rangelands.

The Upper Snake River Valley completely encircles the northern and northwestern portion of the area. Star Valley, created by the Salt River, borders the northeast. The Bear River enters the area near the southeast corner of Idaho. It flows northwest until it makes an abrupt change in direction near Soda Springs, turning south, and in Utah terminating at the Great Salt Lake. Rich river-deposited soils along the Bear River produce a variety of agricultural crops, which create a patchwork pattern of textures and colors that change with the seasons.

Bear Lake, the most significant single visual feature in the area, straddles the Idaho-Utah State line east of the Wasatch Range. The Salt, Snake, Blackfoot, and Bear Rivers add distinctive and pleasant visual qualities to the area. These water bodies support vegetative green belts, which in turn provide optimum habitat conditions that attract a diverse variety of wildlife species.

The Blackfoot Narrows and Diamond Creek valley are popular areas of high local interest and aesthetic appeal. The Blackfoot Narrows (fig. 1-33) is especially popular as a scenic area. Pleasure driving, fishing, hunting, and picnicking are prevalent uses of these localities.

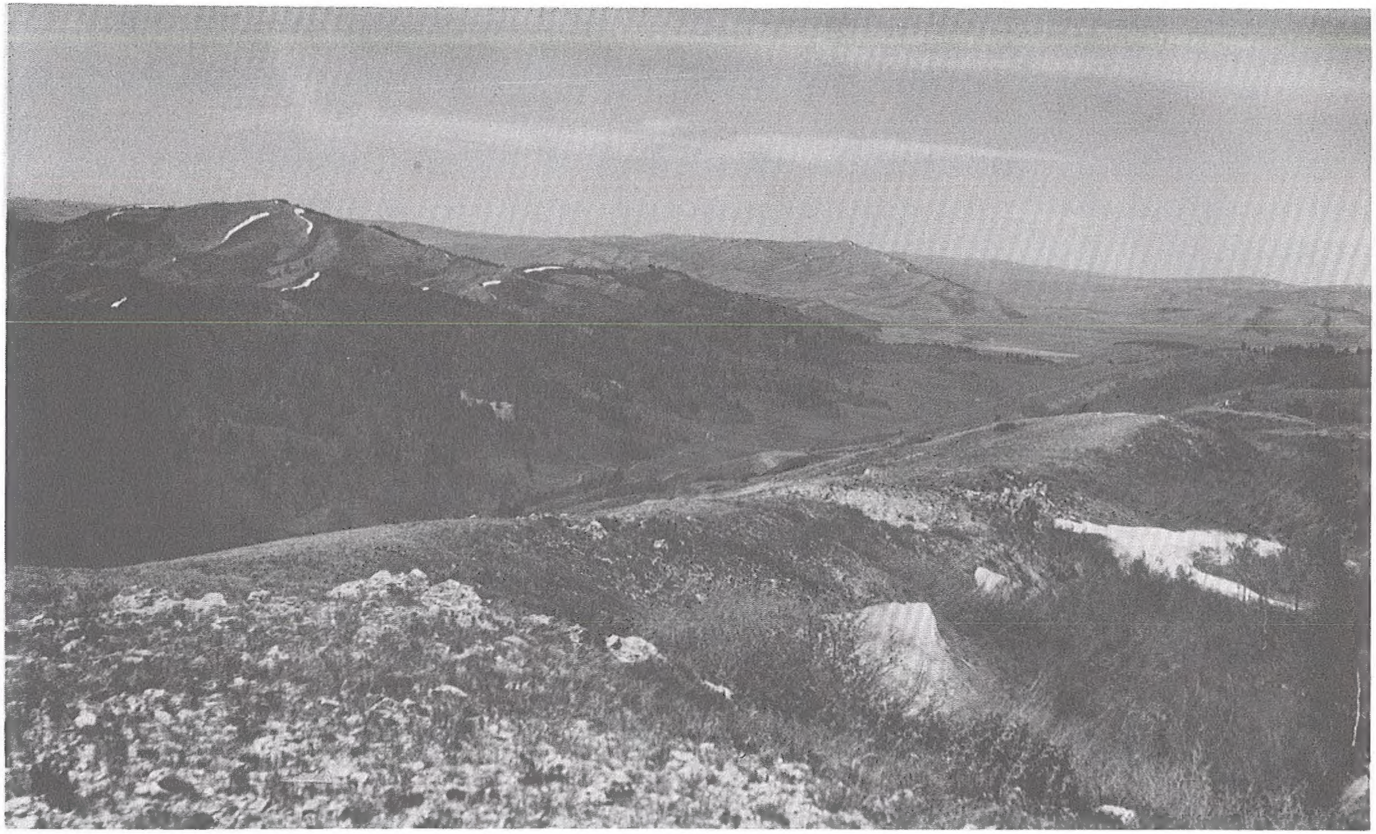


Figure 32a.--Characteristic view of mountain and foothill landscape in the study area.

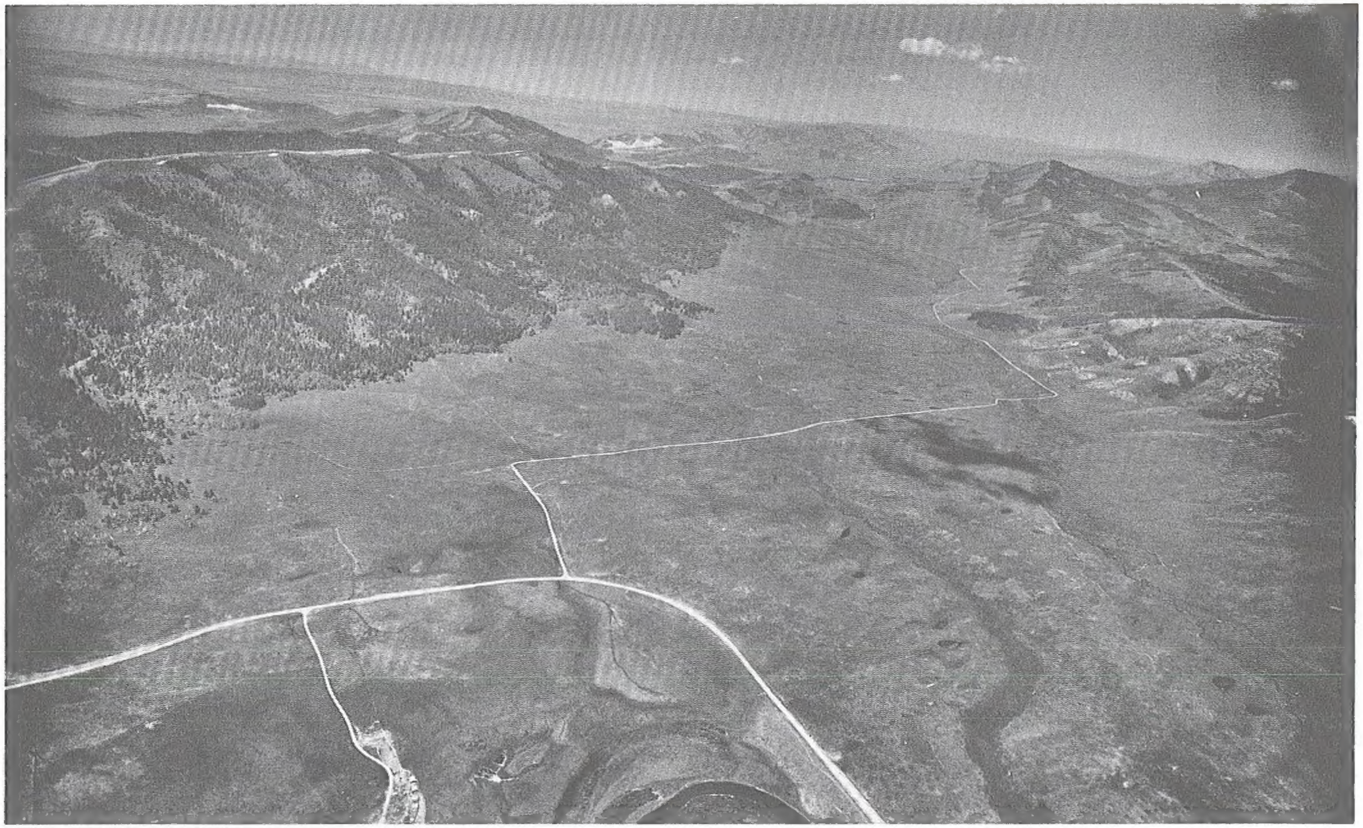


Figure 1-32b.--Characteristic view of mountain and valley landscape in the study area.

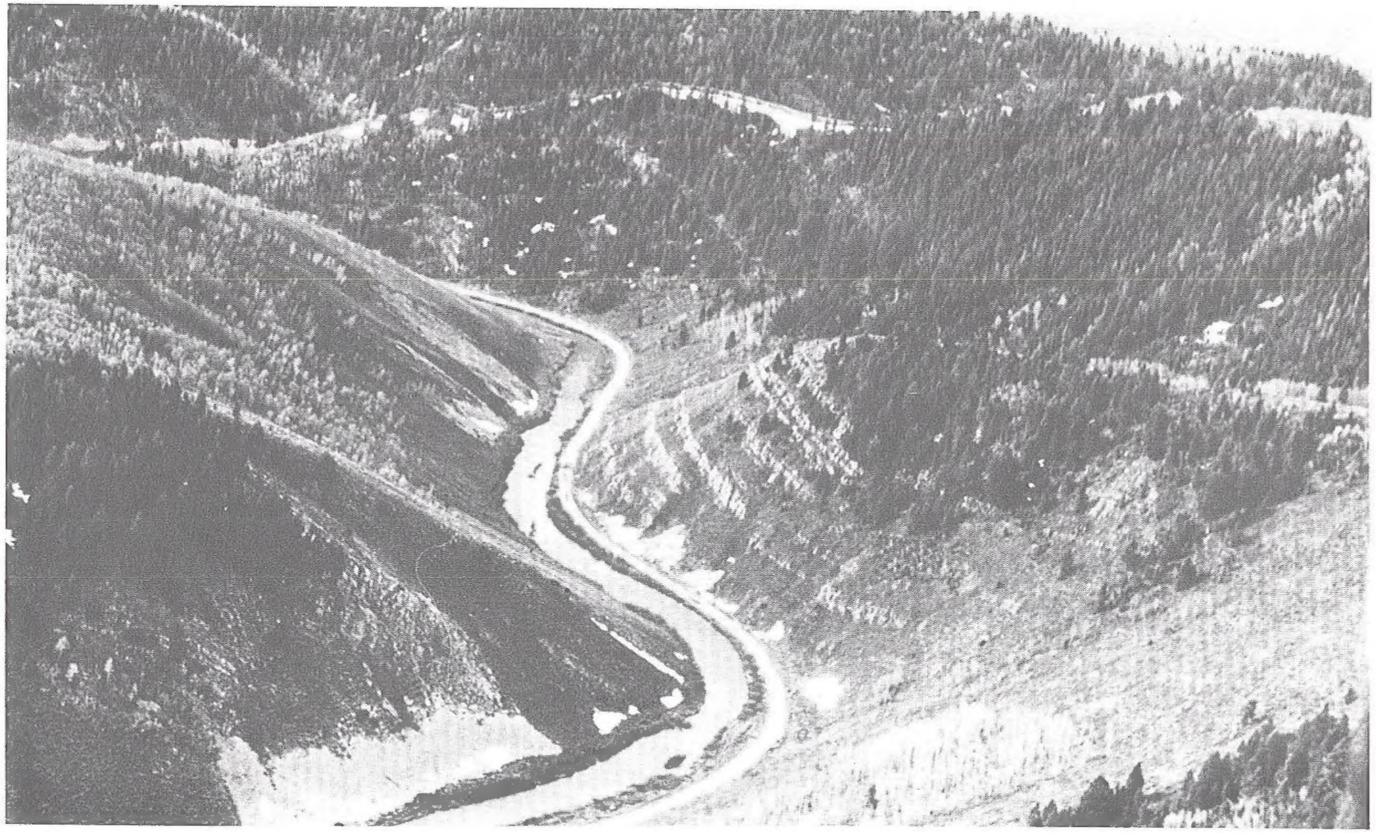


Figure 1-33.--Aerial view of the Blackfoot Narrows, an area of popular scenic appeal.

Manmade intrusions within the study area, causing varying impacts on the land, are primarily roads, industrial development, community developments, powerlines, fenced livestock-grazing allotments, logged areas, the patchwork pattern of agricultural development, and open-pit mines. Within major valley bottom lands, impacts are more acceptable because they are less visible, owing to the flat terrain, and man's activities are expected there. Activities that take place on steeper slopes are more visible for greater distances. Because of the natural character of such sites, manmade impacts can cause greater visual conflicts. Ridgetop open-pit mines, such as the Conda mine, seen from Idaho Highway 34 and the town of Conda (fig. 1-34), the Waterloo mine in Montpelier Canyon adjacent to U.S. Highway 89, and the mine in Georgetown Canyon are examples of existing mining impacts. Access roads and waste areas created by past mining practices on such steep topography have violated the natural line and form, creating excessive visual variety which dominates the landscape. Existing powerlines that run parallel to and to the east of U.S. 30N and U.S. 89 and are conspicuous in the Montpelier and Soda Springs areas, plus the roads used for their installation, violate natural line and color elements. Community growth throughout the study region conflicts with the natural landscape by dominating or eliminating the natural visual elements (fig. 1-35). Industrial developments in the Soda Springs area create road, railroad, utility, and urban features and introduce steam, smoke, noise, and odors into the environment, causing visual degradation to all the elements of the visual and environmental landscape.

Attempts at rehabilitation, such as revegetating and recontouring, are underway as a mitigating measure that will offset some of the visual impacts. These impact features, however, will still be highly visible.

Palisades Reservoir adds variety and interest at the northeastern edge of the planning unit, while the Blackfoot River Reservoir adds variety and interest to the central portion.

Elements of the area that add an historic flavor to the area are the small farms, older buildings, and life style of the Mormon settlers in the Bear Lake Valley (fig. 1-36). Some of the mores of that people still linger. Old ghost towns at Caribou and Williamsburg, Lanes Grave, and Upper, Lower, and Middle Dairy (adjacent to the Lander Cutoff of the Oregon Trail) tell much about the past. This historic trail enters the unit from Star Valley, Wyoming to the east and Stump Creek and proceeds northwesterly to and down the Blackfoot River drainage.

The variety of landscapes in southeastern Idaho provides ample opportunity to compare and evaluate the aesthetic appeal. The Forest Service Aesthetic Inventory and Evaluation Procedure on the BLM Visual Resource Management System can be used to do this. Maps 11 and 12 show the area classified as to visual variety and aesthetic viewing zones according to the Forest Service procedure (U.S. Forest Service, 1974).

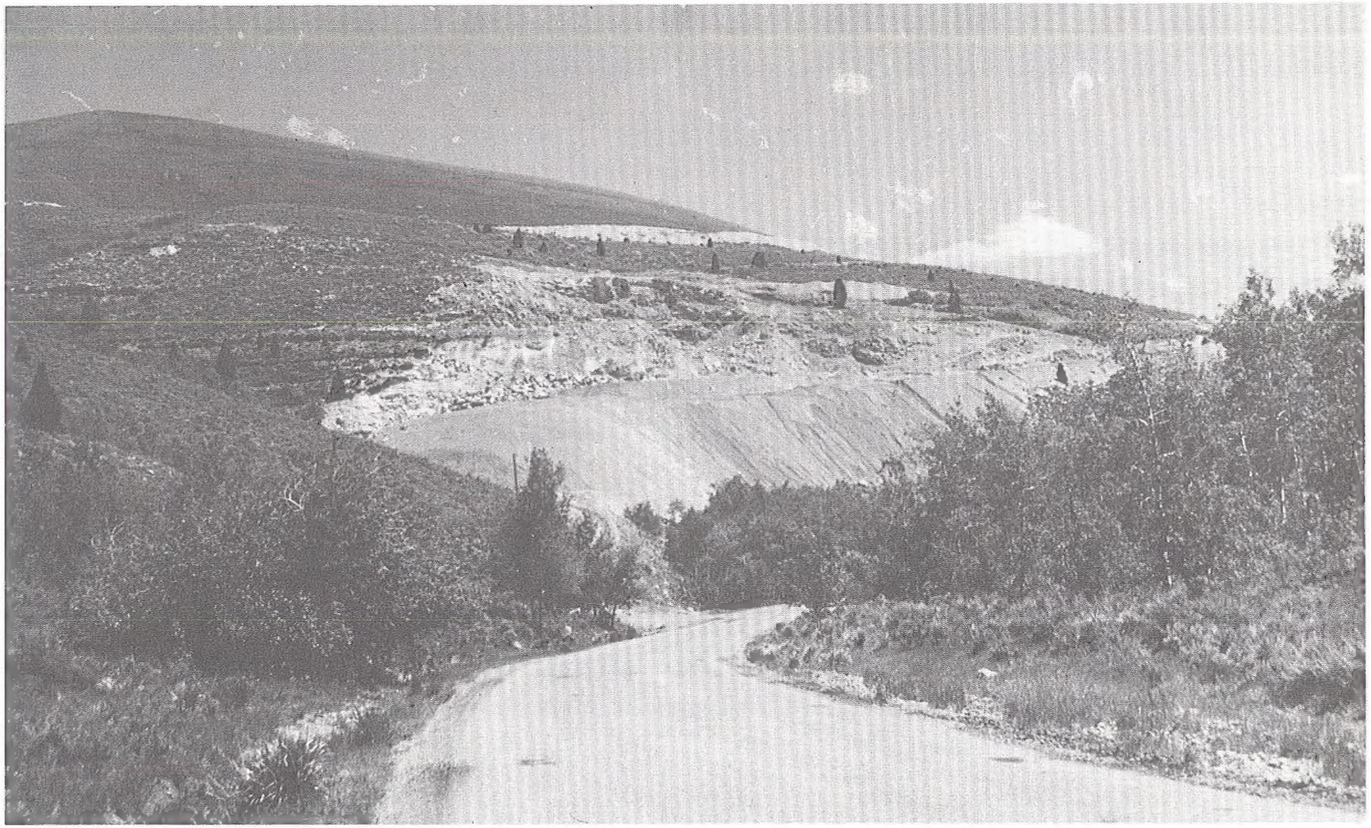


Figure 1-34.--View of mining area from local road.

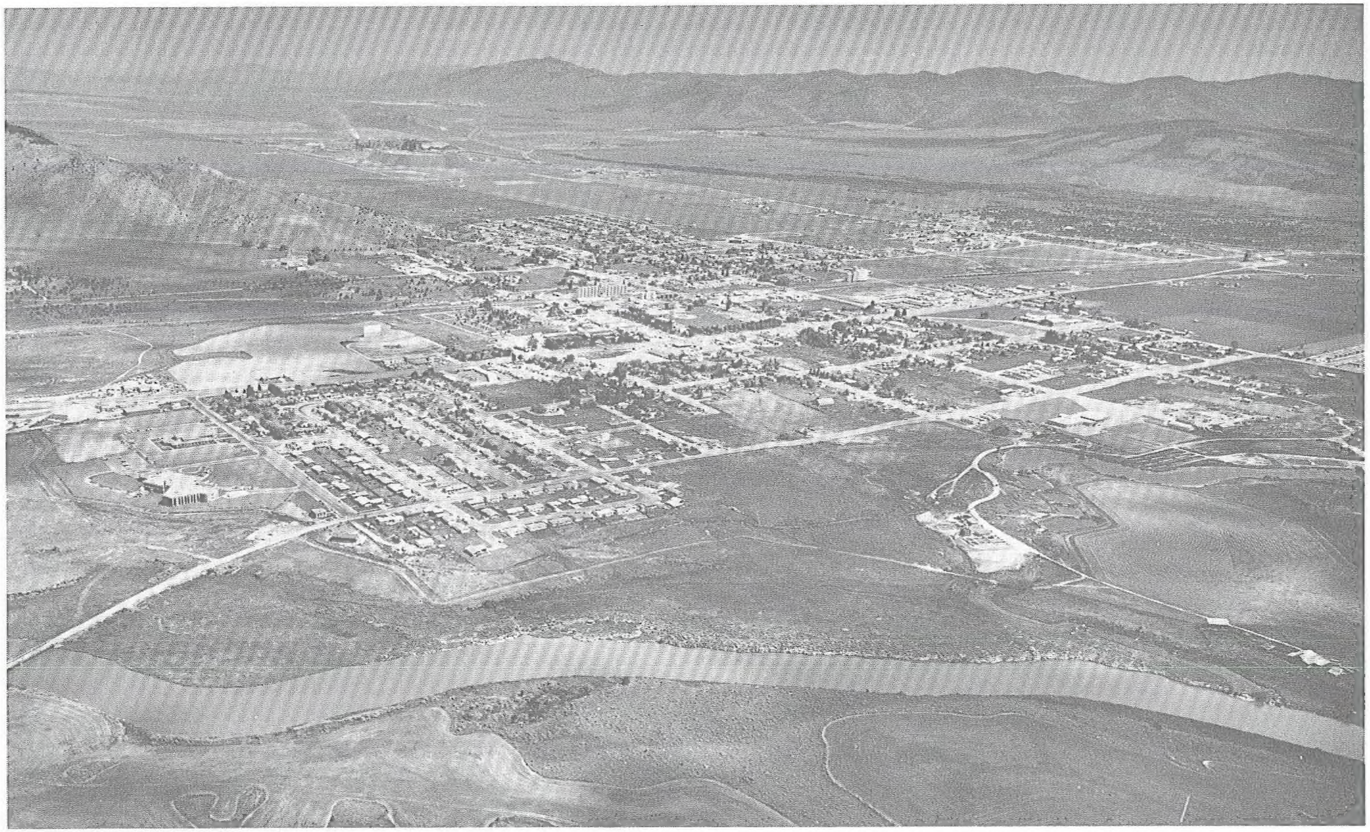
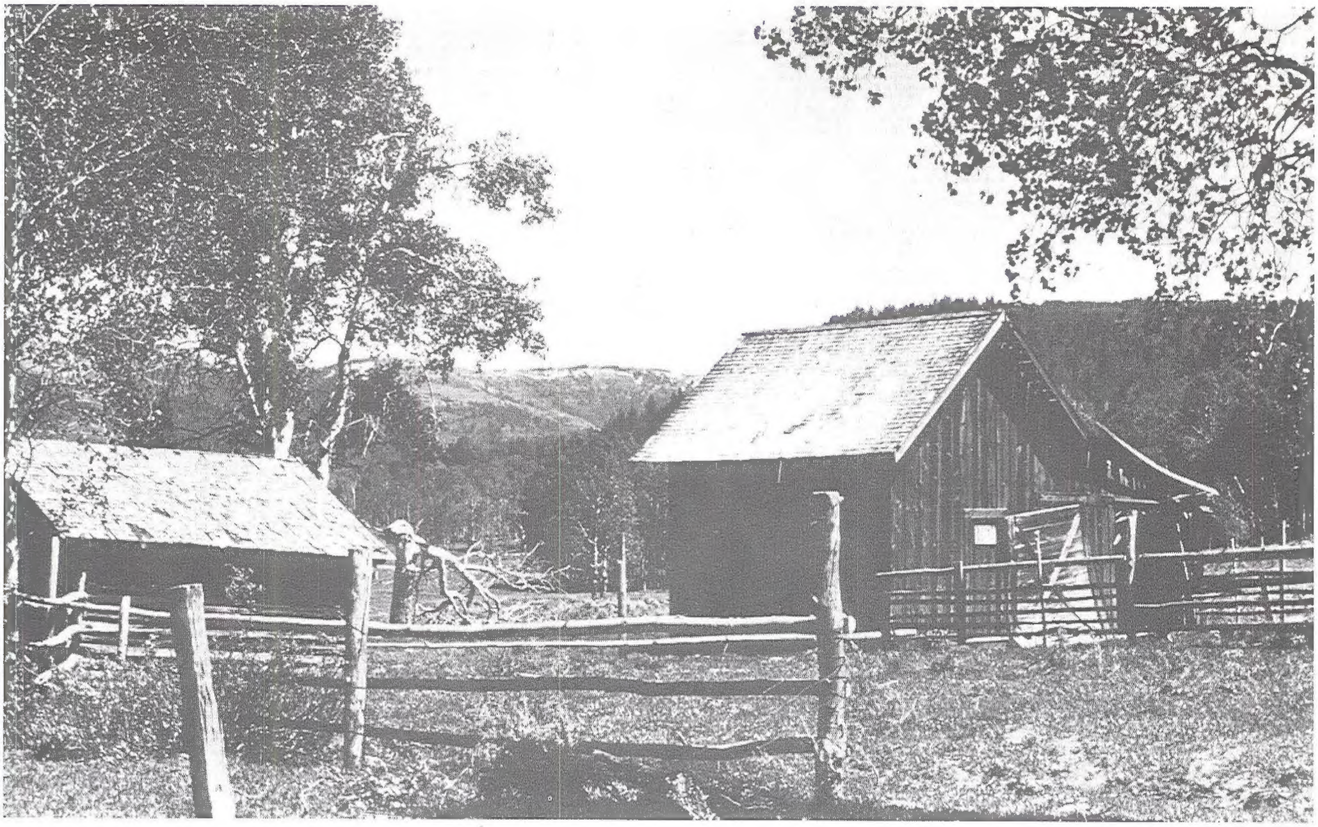


Figure 1-35.--Aerial view of Soda Springs.



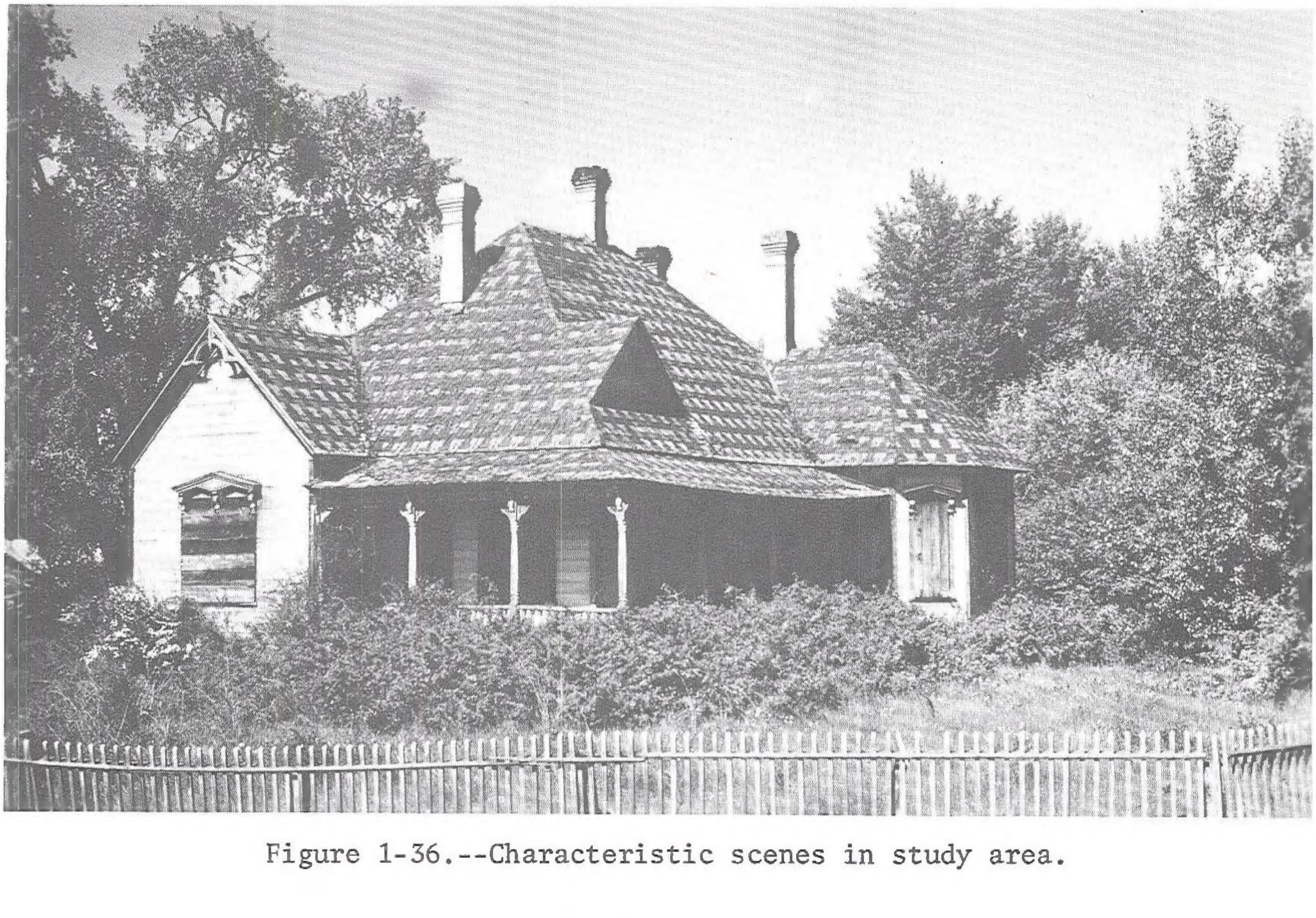


Figure 1-36.--Characteristic scenes in study area.

Landmark features in the area include Blackfoot River Reservoir, Palisade Reservoir, Grays Lake, Dingle Swamp, St. Charles Canyon, Caribou Mountain, Williamsburg, Keenan City, Caribou City, Soda Point Reservoir, Crage Lake, the Lander Trail, and the Oregon Trail.

CHAPTER III
ENVIRONMENTAL IMPACTS

If all mining plans are implemented, 282 million short tons of phosphate will be mined in the region by the year 2000. This is about 30 percent of the known reserves in southeastern Idaho. Mining will likely continue past the year 2000 until the phosphate resources are ultimately exhausted. It is quite possible, however, that mining will not proceed at the rate indicated by the 16 mining plans submitted to the Federal government for approval. Under the proposed schedule of mining, production would approach 20 million tons annually by the early 1980's.

As of September 1976, however, major reductions in estimated mining and processing of phosphate ore have greatly altered the planned expansion. FMC, Monsanto and Beker now plan no expansion in the foreseeable future. Simplot estimates expansion based upon normal growth rates. The Task Force now assumes that the more probable growth of the phosphate industry in Southeastern Idaho will average about 3 percent per year as shown in Table 1-1-a, reaching about 15 million tons annually by the year 2000 A.D.

In the following sections, many of the impacts are given as cumulative quantities, based upon the proposed schedule of mining (table 1-1) and proposed expansion and/or construction of beneficiation plants and proposed expansions of existing processing plants, as originally indicated by the companies and as stated in the mining plans. Until proposed actions are withdrawn, however, they require response and must be considered in this EIS. They therefore represent maximum probable condition. Of prime significance is the fact that the impacts will, if mining occurs at the proposed schedule, occur over a twenty-five year period, with the specific site impacts of mining occurring over the 2 to 25 year period of mining at each site. Some impacts will be limited to the period of mining; others will be long-term and persist long after mining at a particular date ends. The impacts from processing will occur as incremental units at such times as new beneficiating plants may be built or present processing plants expanded. The secondary impacts, mainly socioeconomic, will increase rapidly until the early 1980's, and then tend to level.

Impacts at the lesser, more probable level of mining (see table 1-1a) are also included in this statement.

A. NATURAL ENVIRONMENT

1. LAND RESOURCE

a. Land Surface

Based upon mining plans as originally submitted, the major topographic impact is the change in the land surface that will result from the development of 2,900 acres of mine pits and 3,000 acres of waste dumps. An additional 1,600 acres will be modified by roads, building, and other facilities associated with the mining, and 2,500 acres will be disturbed by off-site transportation and utility facilities.

The following table shows the acreages by incremental periods:

Use	1976-1985	1986-2000	2000+	Total (rounded)
Pits	1,377	1,236	326	2,900
Dumps	1,211	1,436	322	3,000
Other	1,147	295	165	1,600
Off-site transportation/Ut.	1,340	-	-	1,300
Total	5,075	2,967	813	8,900

Individual pit dimensions range from 1,000 to 21,000 feet in length, 200 to 3,400 feet in width, and 50 to 800 feet in depth. The pits will be reduced in size where backfilling is planned. The amount of waste rock produced by 1985 will be about 295 million cubic yards, the cumulative amount by 2000 will be about 820 million cubic yards, and the total production will be about 1,085 million cubic yards. The Paris-Bloomington Mine, the only proposed underground mine, requires only about 3 acres of surface for a small dump.

Some of the pits that are not backfilled will likely be features of public interest and attract visitors like other large or unusual mine pits of this country. Part of the pit at the Diamond Creek mine will be made into a lake, thereby creating a new environment, and possibly providing recreational opportunities.

Beneficiation plants that are proposed near the sites of the Diamond Creek mine in 1977 and the Dry Valley mine after 1980 will require the development of tailings ponds which will alter 840 acres of the surface at Diamond Creek, and 70 acres at Dry Valley.

Based upon a more probable level of mining as shown in table 1-1a, there will be 1,597 acres of pits, 1,770 acres of dumps, and 892 acres of roads and facilities. About 790 acres will be disturbed for offsite transportation in Diamond Creek will require 112 acres rather than 840 acres, and the proposed plant in Dry Valley would not be built. The acreages disturbed on leasehold are shown in the following table:

TOTAL ON-SITE SURFACE DISTURBANCE
1975-2000

		PITS	DUMPS	ROADS	OTHER	TOTAL
ALUMET	DIAMOND CREEK	275	299 + 208(1)	13	60	855(1)
BEKER	MAYBE CANYON N+S	192	214	53	-	459
	CHAMP	37	45	6	4	92
	MOUNTAIN FUEL	102	144	8	-	254
EARTH SCIENCES	PARIS-BLOOMINGTON	-	1	-	16(2)	17
FMC	DRY VALLEY	250	268	36	51	605
MONSANTO	NORTH HENRY	85	85	30	25	225
	TRAIL CREEK	212	300	90	-	602
SIMPLOT	NORTH TRAIL	17	35	-	35(2)	87
	MIDDLE SULPHUR	113	57	-	170(2)	340
STAUFFER	WOOLEY VALLEY #3	129	85	89	12	315
	RASMUSSEN RIDGE	185	29	74	20	308
TOTALS		1597	1770	399	393	4159

(1) 208 acres of the waste dump will be built, revegetated and later removed to the pit and the area again reclaimed.

(2) Roads and other facilities conbined.

b. Geology and Mineral Resources

Based upon mining plans as originally submitted, the geologic impact of the mining is the exposure in the pit walls of the strata of the Meade Peak Phosphatic Shale Member and adjacent rock units. Access to these rock exposures aids in the study of the rocks on a regional basis that is of both economic and scientific value.

The impact upon the mineral resources is the loss of the resources that are mined. The cumulative reduction in phosphate resources, as a result of the proposed mining amounts to approximately 375 million short tons, about 38 percent of the reserves of the region. However, large phosphate resources remain in the region, in addition to the reserves, but are not mineable under present conditions.

Other resources that are contained in the phosphate rock and the vanadiferous-zone rock of Bloomington Canyon and that will be removed from the mine sites amount to approximately 9.1 million short tons of fluorine, 360,000 short tons of vanadium, 41,000 short tons of uranium, and 380,000 short tons of rare earths (lanthanons and yttrium), 7,600 short tons of selenium, 6,300 short tons of cadmium, 540 short tons of thallium, 220 short tons of silver and 32,000 short tons of zinc. Of the resources in phosphate rock, only vanadium will be utilized. Of the resources in the vanadiferous-zone rock, selenium, zinc and silver will probably be recovered in addition to vanadium.

Backfilling of some pits with waste rock, as proposed in some mining plans, will have a significant impact upon mineral resources. It will block access to additional oregrade phosphate resources that will extend downdip from the bottom of the pits and that could be recovered in the future. Backfilling will cause ore losses where soft altered ore extends below the pit. Backfilling pits where the alteration limit has been reached will not preclude mining the competent unaltered rock by underground methods at some future date. Underground mining will of course, recover significantly less of the phosphate. The U. S. Geological Survey regulation, 30 CFR 231, states that mining operations shall be conducted in a manner to yield the ultimate maximum recovery of the mineral deposits, consistent with the protection and preservation of the environment including land, water, and air.

Based upon a more probable level of mining, as shown in table 1-1a, 246 million tons of phosphate, or about 25 percent of the reserves of the region, will be mined.

c. Soils

Based upon mining plans as originally submitted, the cumulative soil-related impacts of mining and processing phosphate rock in southeastern Idaho will be significant. The major impacting actions will be the actual mining of ore and removal of over-burden over the 25-year period and the building of transportation facilities.

Unless topsoil is salvaged, the mining and associated construction activities and transportation networks will result in the destruction and mixing together of all the existing soil types and horizons on a total of 8,900 acres. This is less than 1 percent of the study area.

The degree of alteration and soil mixing will vary from site to site. It will be nearly complete at the actual minesite. Certain utility lines will result in only minor disturbances and mixing of soils. This displacement of soil will change all soil characteristics and will modify micro-organisms and soil relationships which have been established over a long period of time. Fine-grained soil and parent material will be exposed to wind and water actions. Permeability and infiltration rates will likely be reduced. Runoff, soil erosion, and sedimentation will increase, and wind action will probably pick up fine particles from exposed surfaces. This will reduce air quality and add to soil loss. Since all physical, chemical, and biological systems will be disrupted to some degree on disturbed areas, and some of the mine)its will not be reclaimed, there will be an overall lowering of soil roductivity.

Some stream channels will be altered or converted to conduits. These changes could increase velocities, which will increase the rates of erosion from stream banks and beds both onsite and downstream. Release of surplus water tapped in the mine pits could accelerate erosion if releases are not kept at tolerable levels. Some transportation routes are located in areas having soils with moderate to high slumping potential. Slumps could occur, destroying segments of transportation systems and, on occasion, dumping soil directly into streams.

Some sections of proposed roads and railroads, notably the Swan Lake Gulch and Dry Canyon haul roads and the Blackfoot Narrows railroad, would require large cuts or fills on steep slopes. Surface erosion and mass stability will be continual problems in these areas.

Large areas will be disturbed for offsite uses such as housing, double tracking of existing rail lines, and widening of existing roads. Stabilization of these areas should be possible. Soil losses should be minimal, but loss of vegetative production will be significant.

It is possible that emissions from processing plants may cause soil pollution and chemical changes in soil, but the significance of this possibility will be localized. Limited data on concentrations of 14 trace elements in soils in the Pocatello area indicate that concentrations within 1 mile of the processing plants are about two times those 30 miles from the plant; concentrations of fluorine, three times those 30 miles from the plants. Concentrations of fluorine, lead, mercury, manganese, and zinc all are at unusually high levels within mile of the plants. This pattern, however, was not found in the Soda Springs area, probably because of the diversity of the soil. Further details are given in the section on vegetation in this chapter.

Based upon a more probable level of mining, as shown in table 1-1a, a total of 4,159 acres of soil will be disturbed, of which 2,634 acres will be reclaimed.

2. WATER RESOURCES

a. Water Supply

1. Surface Water

Based upon mining plans as originally submitted, the greatest impacts on mining on the surface waters of the study area will be changes in flow patterns and water quality. These changes cannot easily be quantified because of the limited available data for the specific minesites; namely, (1) location and size of snowdrifts, (2) distribution between overland and subsurface flow from snowmelt or precipitation, (3) directions of flow and depths of ground water, (4) duration, timing, and quantities of surface flows, including flow of springs, and (5) quantities of sediment movement.

Under present conditions at some of the proposed minesites, accumulated snow melts at rates permitting percolation into the ground, and overland flow is minor. At other mines, considerable amounts of overland flow may reach drainage channels in the mining areas.

Infiltration through the post-mining surfaces could be significantly less than, it is under present conditions, and the overland flow could be significantly increased.

Excavating about 2,900 acres of open pits, dumping waste on about 3,000 acres, and disturbing about 1,400 acres for other uses would alter infiltration through removal of vegetation, litter, and soil cover and through resorting and compaction of waste materials by mining equipment in both backfills and dumps.

The effect of this change is difficult to predict. Increased velocities as a result of increased surface flows would accelerate erosion of stream beds and banks and thus increase sediment loads. Some channels and pits would absorb these increases, and effects would extend only short distances downstream. In other channels, the effects may carry for long distances. Retention ponds in some cases may be inadequate to trap the sediment from the increased flows. Existing ponds in some cases have not proven adequate. Should dump failures occur, sediment would be a long-term, persistent problem. Available data do not permit determining with certainty at this time which channels would be impacted, which ones would absorb the increased surface flows, and what the degree of resulting impact would be.

There are only scanty data on the relationship of rainfall and snowmelt with runoff for most small basins within the study area, and the hydrologic characteristics of this area are unique enough to preclude transfer of data from other areas where adequate data are available. Thus, statistical projections of runoff events are of limited value, and description of the impacts from runoff are largely subjective.

However, some of the present mining operations have caused little impact to surface streams because all surface runoff has been confined to the mining area. Some sediment movement has occurred and continues at others. Some open pits may intercept and change the course of sizable underground flows, and others will receive seepage from regional ground-water bodies that are fed by surface streams. These and other situations will disrupt natural flow patterns. At some mines, considerable pumping from pits to surface streams may be necessary. Possible underdesign of French drains, culverts, bypass channels, and drains across and around mining areas would result in channel aggradation or degradation, bank or dike overflows, or structural failures. Such underdesign could result from lack of detailed hydrologic data, especially snow accumulation, for design.

Concurrent operations of several mines in one drainage could compound individual impacts. For example, impacts on Diamond Creek could be compounded by the concurrent operation of Alumet's Diamond Creek mine and IMC's Husky No. 1 mine. Impacts could be further compounded in the Maybe Creek and Dry Creek drainage. Beker's South Maybe

Canyon, IMC's Husky No. 1, and FMC's Dry Valley mines are all, or in part, within these two drainages. The South Maybe Canyon mine, however, is likely to present greater possible impacts for Maybe Creek within the next 4 years. It is expected to start operation in 1976 and to be completed before the FMC mine starts in about 1981. The IMC mine is planned to start in about 1978 and will overlap the South Maybe Canyon mine operation by about 2 years.

The proposed slurry lines for transporting ore could result in serious deterioration of surface-water quality in the event of rupture. Release of large volumes of untreated slime into surface streams, either by accident or by seepage from tailings ponds, has caused serious impacts in other areas and could be hazardous and difficult to control in the mountainous terrain of the phosphate area. Considerable but unquantifiable impact on water quality and streamflow characteristics could also result from inadequate bridges, culverts, and other hydraulic structures and by long reaches of road fills or other construction within or adjacent to the stream channels. Erosion, with attendant sediment discharge, will be seriously increased, especially during and shortly after construction. Such disturbed land surfaces, if not reclaimed, will continue to contribute sediment to streams for long periods of time.

Runoff from the transportation corridors will likely contain both sediment and pollutants from usage. Qualitatively, cumulative impacts from the transportation systems appear both equal and similar to impacts from one of the larger proposed mines.

Impacts on quality of surface water from the processing plants would be significant if waste water or cooling water were discharged directly from the plants to surface streams. Toxic and other contaminants contained in the effluent could seriously pollute surface streams.

Consumptive use of water for processing, estimated at a maximum of 74,000 acre-feet annually, will likely come from ground water. Whether diverted from surface-water or ground-water sources, the water used consumptively would result in a net reduction of flows in surface streams in most instances. All surface flows in both the Bear and Snake River basins are now appropriated for other uses, except for flood flows. Increases in energy demands with attendant development of new power sources would need water for cooling and consumptive use if additional plants were constructed in the study area. The impact of this factor cannot be assessed at this time because it is not known if additional powerplants are proposed for the study area. Such impacts cannot be assessed until such time as a specific site, type of plant, and capacity are proposed.

Based upon more probable level of mining as shown in table 1-1a, the impacts to surface water would be reduced to those from 4,159 acres instead of 7,300 acres.

2. Ground Water

At both levels of production, as shown in table 1-1 and 1-1a, some mining operations, including pit development, backfilling, and disposing of waste, will alter ground-water recharge and discharge relationships. The pits could become discharge points for some ground-water systems; if the pits fill because of flashy runoff, they could become temporary recharge sites and possibly could be classified as drain wells under Idaho law. Pits in which the Wells Formation or the Rex Chert Member of the Phosphoria Formation are extensively exposed would be particularly subject to either recharge or discharge, depending on the relationships of water levels in the pit and in these formations. Because most proposed pits are above significant aquifers, effects in most cases will be localized.

Mining will interrupt some alluvial and bedrock aquifers, and some local perched ground-water bodies will be permanently drained. Backfilling will not restore these aquifers, although the fill may become saturated. Water levels will be lowered in the vicinity of the mines while mining progresses; the extent will depend upon aquifer properties, rate of discharge into the pits, rate of pumping wells for the purpose of lowering water levels, and the length of time the pit is open or that pumping occurs, and will vary from mine to mine. Lowering the water levels could affect water levels in nearby wells, discharge of nearby springs and seeps, and the flow of nearby streams. Where substantial quantities of ground water are drained or pumped, the discharge of seeps, springs, and streams some distance away--even in other drainage basins--could be diminished. Backfilling of pits dug in recharge areas would prevent or reduce recharge in the pit area. Waste materials deposited on recharge areas would also stop or reduce recharge. This would be mostly of local significance; the net loss of recharge over the entire area would be small when compared with total recharge.

Roads, railroads, and powerlines associated with the increased mining and processing will not greatly affect ground-water systems. There will be some loss of recharge areas where fills are made, and the cuts in hillsides may drain some small ground-water bodies. Ditches dug for gas or slurry transport in pipes could intercept shallow aquifers and have to be drained; however, once installed, the pipelines should have little further impact.

Records of ground-water levels in the Michaud Flats, where the present processing plants are located near Pocatello, indicate that with-drawals for irrigation and processing-plant use to date have not lowered water levels significantly. However, additional large withdrawals of water could lower ground-water levels and decrease the flow of the numerous springs discharging into the Portneuf River below the plant-sites. Records also indicate that ground-water levels in the Conda-Soda Springs area have not been lowered at the present rate of withdrawals. Increased withdrawals to meet the demand of additional processing requirements, especially if the withdrawals are made west of the present plants at properly selected sites, probably would not significantly lower water levels.

Increased withdrawals of ground water in the Conda-Soda Springs area could cause a slight change in ground-water quality. The carbonated water being discharged from springs and known to be present at depth under high pressure in this area differs from the water being recharged from the Blackfoot River and Blackfoot River Reservoir. Increased withdrawals could lower water levels locally and reverse natural gradients so that water from an area of different water quality could move toward the pumping centers. The aquifer characteristics and geometry, location of the pumping centers, and quantity pumped will determine these ground-water gradients. If more water is induced into the ground-water system from the Blackfoot River or Blackfoot River Reservoir, the quality of the pumped water will not be affected significantly, but it could possibly improve. If carbonated water from deep sources is induced to move into new pumped areas, the quality probably will deteriorate somewhat.

Improperly constructed and sealed settling, slime, slurry, gypsum, and evaporation ponds are potential sources of contaminants to both surface water and ground water. Some dissolved constituents in pond water, such as nitrates, sulfates, and fluorides, can move long distances underground. Suspended fine-grained materials in slimes commonly approach collidal size, and once they escape confinement structures, such as ponds or ditches, can be transported in natural streams or underground in fracture systems for long distances.

Based upon a more probable level of mining, as shown in table 1-1-a, the impacts to groundwater would be reduced to the extent that mining did not occur. Local impacts to groundwater would be largely from 1,597 acres of pits rather than 2,900 acres.

b. Water Quality

Based upon mining plans as originally submitted, the greatest impacts to water quality in the proposed mining area will result from increased erosion on the disturbed land and subsequent increased rate of suspended- and bedload-sediment transport in the stream channels. The impact is not only disfiguration of the land surface because of accelerated erosion, but if the supply of sediment to the stream channels is greater than the streams are competent to transport, deposition will occur.

Channel degradation will likely change streamflow characteristics. Decreased channel-carrying capacity resulting from deposition of sediments will result in a greater frequency of overbank flooding. This will be compounded by increased runoff rates due to vegetation removal and soil compaction. A net effect could be a further increase in erosion by channel bank cutting and flood plain damage caused by frequent overbank flows. Sediment-retention ponds, stock-watering ponds, and major downstream reservoirs would have their useful lives shortened if increased erosion provided substantially higher sediment yields.

Accelerated erosion could result from destruction of the vegetation cover and alterations of the local topography at proposed mining sites. The construction of supporting roads and facilities could destroy or damage vegetation cover over broad areas. The stripping of ground cover from weather and unconsolidated materials could result in very rapid erosion of rills and the formation of gullies on all but the most gentle slopes during times of surface runoff.

The proposed mining activity and related construction would disrupt existing surface drainage systems wherever they cross slopes. Concentrating surface and subsurface water into channels in order to direct it through culverts could result in accelerated erosion beyond the culverts, owing to locally increased discharge.

Downslope from excavated or compacted areas, decreased subsurface flow could alter the vegetation cover and thus locally change the hillside stability. Changes in the form of drainage could alter the freeze-thaw, wet-dry, liquefaction, or other characteristics of soils, leading to new or accelerated soil creep and more rapid forms of mass movement. A principal potential impact of such soil movements would be the disfiguration of the landscape and a decrease in the quality of water.

Spoils areas are obvious sources of increased sediment yields by erosion. Initially, they are void of vegetation and even with successful revegetation schemes, there is a period of time when they have increased erosion potential.

As mentioned earlier, the net effect of increased erosion will be increased sediment-transport rates in stream channels. Although the values of suspended-sediment concentration cannot be correlated directly with impacts on the basis of the data available, the range in concentrations will increase at locations downstream from major mining and construction activities. In some stream reaches, suspended-sediment concentration may temporarily be as much as 10 to 1,000 times greater than normal. The permanency of such increases will be dependent upon the undertaking of adequate mitigating measures. Absolute values of suspended-sediment concentrations are sensitive to many variables. Without precise knowledge of mitigating measures, only order of magnitude changes can be estimated for values of suspended-sediment concentration.

At bankfull stage, stream channels in the proposed mining area show about a 10-fold range in values of suspended-sediment concentration. This is about the same range in values observed for a number of undisturbed streams in the upper Salmon River of south-central Idaho. The Salmon River study also indicated that for several streams disturbed by mining, road construction, and other activities, values of suspended-sediment concentration at bankfill discharge were about 10 times higher than those of undisturbed streams. No significant mitigating measures were undertaken for streams of the Salmon River study, or the increase in suspended-sediment concentration might have been held to a lower level.

Assuming that the impact increase in suspended-sediment concentrations in the proposed mining area might also be about 10-fold, the natural variability of suspended sediment is such that if the impact occurred to a naturally "clean" stream, the net result would be a stream no more laden with sediment than a naturally "dirty" stream. However, the circumstances could be such that the impact occurs to an already sediment-laden stream and results in a much dirtier than average stream.

One effect of impact on values of suspended sediment is to increase the rate of suspended-sediment concentration as discharges increase. The net result is that the impact is greatest at high values of discharge, primarily above bankfill discharge. Since discharges of this magnitude generally occur for only a few days each spring, if mitigating measures were seasonally timed to allow for seasonal phenomena, the impact of various mining and construction activities could be minimized. Most likely then, if adequate mitigating measures are provided and enforced, impact on most stream channels would be within limits of natural variability. Except for temporary and localized instances, increased values of suspended-sediment concentration could be held to natural, or at least acceptable, limits.

The Forest Service has estimated potential sediment yields due to the proposed mining for the nine mines involving national-forest lands. These estimates are based upon the Musgrave formula and a number of assumptions. Although the Task Force has reservations on the applicability of the Musgrave formula to southeastern Idaho and on some of the assumptions, the qualitative estimates are presented here as indications of potential sediment yields. They are based upon the effectiveness of past reclamation measures. Actual yields could vary significantly from those presented. The Forest Service estimates are as follows.

About 53 miles of significant stream channels will be impacted in varying degrees by the nine mines analyzed. The greatest predicted impact is in Stewart Creek where the sediment will be increased more than 30 times the existing conditions.

Estimated increases in sediment for each of the nine mines were calculated for each year from 1976 through 1999. No similar values for undisturbed conditions are developed. According to this analysis, the Husky No. 1 mine will produce the most sediment, and Mountain Fuel mine will produce the least. The Husky No. 1 mine proposal listed two waste dump areas--one as an alternative to the other. Since no criteria were given for selection, both were used in this analysis.

Predictions were made for 21 stream reaches. The predicted combined impacts of two or more of the proposed mining plans follows. Stream reaches that will be affected by only one mine are discussed in Parts 4 through 11.

The Blackfoot River from Diamond Creek to the National Forest boundary below the Blackfoot Narrows will receive sediment from the Wooley Valley mine, the Lanes Creek mine, the Rasmussen Ridge mine, the Diamond Creek mine, and the Husky No. 1 mine. Data for the Wooley

Valley mine and the Lanes Creek mine are not available.

The combined impacts of the Diamond Creek mine, the Husky No. 1 mine, and the Rasmussen Ridge mine are predicted to increase sediment in this stream reach during mining to 2 to 3½ times the existing load and after mining to 1½ to 3 times the existing load. This increase in sediment load will cause some increase in deposition in pools and eddies and along meander bends of the river. The existing rates of sediment production are very low; during and after mining the rates would be low to moderate. The impacts on the general appearance of the stream should be small. The impacts on water uses are uncertain.

Diamond Creek, from Timber Creek to Lanes Creek, will receive sediment from the Diamond Creek mine and the Husky No. 1 mine. During mining, sediment yields are expected to increase from 3 to 6 times the existing amount. After mining, sediment yields are predicted to decline to 2½ to 5 times the existing amount. Such increases in sediment yields are expected to coat many segments of the streambed with fine sediments and could increase the frequency of channel changes. The number and size of sand bars are expected to increase. The existing rate of sediment production is low; during and after mining, the rates would be moderate to high.

Lanes Creek, from Sheep Creek to Diamond Creek, will be affected by the Rasmussen Ridge mine and the Lanes Creek mine. Angus Creek, from North Fork of Angus Creek to the national-forest boundary, will be affected by the Rasmussen Ridge mine and the Wooley Valley mine. Angus Creek, from its headwaters to the confluence with the North Fork of Angus Creek, will be affected by Rasmussen Ridge mine and the Wooley Valley mine. Estimates for these three reaches are available only for the Rasmussen Ridge mine and are discussed in Part 11.2.

Maybe Creek, from its headwaters to the national-forest boundary, will be affected by the South Maybe Canyon mine, the Husky No. 1 mine, and the North Maybe Canyon mine. Estimates for the North Maybe Canyon mine are not available. Sediment loads are expected to increase during mining to 10 to 21 times the existing load and to decline after mining to 7 to 15 times the existing load. The stream channel has been and is now adversely affected by accelerated sediment loads from existing roads and from past and ongoing mining activities. Sediment increases in Maybe Creek may adversely affect the use of water from Maybe Creek for both mining operations and for stock watering. The effects of increased sediment on Maybe Creek cannot be predicted at this time. Maybe Creek is tributary through Dry Valley Creek to the Blackfoot River below the Blackfoot Narrows. The existing rate of sediment production is low; during mining, sediment production rates would be very high; after mining, high to very high.

Lower Dry Valley Creek, from the headwaters to the National-Forest boundary, will be affected by operations associated with the Dry Valley mine, the Champ mine, and the Husky No. 1 mine. Below the National-Forest boundary, Lower Dry Valley Creek will also receive flows from Maybe Creek. The sediment loads are predicted to increase to 6 to 12 times the existing lpad during mining (about 1985) and to decline following mining to 3 to 6 times the existing load. The existing rate of sediment production is very low; during mining, the rates would be moderate to high; after mining, low to moderate. These sediments are likely to change the character of the stream bottom deposits and may increase the frequency of stream channel changes. Dry Valley Creek is tributary to the Blackfoot River and has been observed to flow on the surface from the national-forest boundary to the Blackfoot River.

Upper Dry Valley and Dry Canyon will receive sediment from the Champ mine, the Mountain Fuel mine, and the Husky No. 1 mine. During mining, sediment yields are predicted to increase from 3 to 7 times the existing amount; after mining, sediment yields will decline to 2 to 5 times the existing amounts. The existing rates of sediment production are very low; during mining, the rates would be low to moderate; after mining, very low to moderate. Ground-water recharge areas will probably intercept some of this predicted increase and will reduce the time that flows would transport sediment if this were totally a surface-flowing system. The channels in Upper Dry Valley and Dry Canyon will not be damaged by increases in sediment. Below the national-forest boundary, springtime flows from Dry Canyon join Slug Creek and eventually the Blackfoot River.

Goodheart Creek, from the headwaters to the nNational-forest boundary will be affected by the Dry Valley mine, the Mountain Fuel mine, and the Husky No. 1 mine. Sediment loads are expected to increase during mining 2 to 4 times the existing load and to decrease following mining to 1¼ to 2 times the existing loads. The existing rates of sediment production are very low; during mining, the rates would be very low to moderate; after mining, very low. The likely effects of such small increases in sediment are unknown. Goodheart Creek is tributary through Slug Creek to the Blackfoot River. These predicted small amounts of sediment by themselves will probably be insignificant to the larger streams.

Johnson Creek from the confluence of Dry Fork of Johnson Creek to the National Forest boundary will receive sediment from the Swan Lake Gulch mine and the Middle Sulphur mine. During mining, sediment loads are predicted to increase 1½ to 2 3/4 times the existing conditions. After mining, sediment loads are predicted to be 1¼ to 1 3/4 times the existing load. The existing rate of sediment production is very low; during and after mining, the classification would not change. The effects of these small increases are uncertain but are expected to be insignificant. The major water-quality problem relates to the proper design and placement of sediment ponds along and in the stream valleys. Breaching of sediment ponds and retaining dams during periods of high snowmelt runoff is possible; the resultant transport of extremely high suspended sediment loads would have deleterious effects on the Blackfoot River.

The Phosphoria sediments contain higher concentrations of trace elements and nutrients than do most rocks. The trace elements include arsenic, cadmium, lead, molybdenum, selenium, vanadium, zinc, and the radioactive elements uranium and radium. The nutrient nitrogen occurs as constituents of minerals and as organic material. The mineral fluorapatite, a primary component of phosphate rock, is the main source of another nutrient, phosphorus, as well as fluoride. Dissolution of fluorapatite will also increase fluorides.

All these constituents can be released from sediment to the water under certain conditions, which could degrade water quality. However, natural factors tend to prevent most toxic elements and nutrients from dissolving to form high concentrations in the water.

One of the most important mitigating factors is the ubiquitous presence of carbonate minerals associated with the Phosphoria sediments. In their absence, the mineral pyrite (iron sulfide) could produce acidic solutions when oxidized during mining, thereby releasing toxic constituents by dissolving the rock components. This occurs, for example, in coal-mining and some ore-mining regions. In the Phosphoria deposits, however, any acid produced by oxidation of pyrite is neutralized by reaction with the carbonate minerals.

The immediate control on pH in the water sources of the study area is the carbon dioxide system, which causes the pH to fall generally into the range of approximately 6 to 8. In this range, many trace elements exhibit their minimum solubility, and many form positively charged cations and are attracted (adsorbed) to negative charges on surface sites of minerals. Adsorption may cause the concentration of an element in solution to be much lower than that predicted by solubility. This would not apply to aqueous ions that are in equilibrium with the solid phase. The concentration in the water predicted by solubility would represent a maximum value. Formation or complex ions might increase the predicted concentrations above that based on solubility calculations.

Although mining operations may not increase the dissolved concentrations of some trace metals, such as lead and cadmium, this is not true for other metals such as vanadium, which can exist as an anion under some conditions and, therefore, would not be as strongly adsorbed as the cations, lead and cadmium. In one sample from Angus Creek, analyzed by the U.S. Geological Survey in late 1974 when the creek had low flow, the concentration of vanadium was 52 ug/l. Because vanadium is somewhat mobile, it and similar elements need to be monitored in the area, particularly around existing and projected ore-processing plants. A Geological Survey analysis of the cooling-pond solution at Beker's Conda plant showed a vanadium concentration of 5,900 ug/l on December 12, 1974. However, no hazardous vanadium concentrations have been measured in the water sources sampled.

Other elements, which are undesirable if present in significant concentrations in water, also occur in the Phosphoria: arsenic, molybdenum, selenium, chromium, zinc, and the radioactive elements uranium and radium-226. Some or most of these elements occur in waste solutions associated with the ore-processing plants at Pocatello and

Conda. Concentrations of arsenic, cadmium, copper, lead, selenium, and zinc were very low in selected stream waters analyzed by the Geological Survey and Forest Service during low-flow conditions in late 1974. Mining will result in slight increases in metal concentrations.

Data from the Idaho Division of Environment suggest a causative relation between the arsenic in solutions of an evaporating pond in Pocatello and the arsenic in the water of nearby wells. The proposed beneficiating and calcining plants will likely release elements to solution, which at sufficient concentrations are toxic. In some cases, the natural constraints on transport of some of these may be overwhelmed, permitting their concentrations to rise to undesirable levels, at least locally.

Nothing is known about the present concentrations of uranium and radium in the surface water of the region. Unpublished data from the Geological Survey on ground-water sources suggest, however, that their present occurrence is negligible, even in the wells of ore-processing companies where arsenic and nitrate contamination is obvious. Much of the radium liberated during the manufacture of fertilizer ends up in the waste product gypsum, which is stored in piles at the processing plants. Because gypsum is moderately soluble, some radium might contaminate ground water. Soil and sediment should adsorb the radium as the charged water percolates through the ground, thereby preventing excessive contamination of the ground water.

Nitrate and other forms of combined nitrogen are important nutrients which, in high concentrations, can cause eutrophication (overproductivity) of streams and lakes. The water in some wells near processing plants at Pocatello and Conda contains more than 44 ppm of nitrate as NO_3 (10 ppm as N), the upper limit recommended by EPA for nitrate concentrations in drinking water used for feeding infants. One of the minerals in the Phosphoria, a feldspar called buddingtonite, contains up to 6 percent of the nitrogen-bearing ammonium ion, as $(NH_4)_2O$, but it is not thought to weather readily and, therefore, may not release much nitrogen to the water. However, nitrogen-bearing organic material may add appreciable amounts of nitrogen to the water, a suggestion seemingly supported by the significant concentrations of total Kjeldahl nitrogen (about 1-2 ppm as nitrogen, and a measure of ammonium ion and organically bound nitrogen) in most streams. Increased mining may increase this load by making more nitrogen compounds available to solution.

It is not clear that the high nitrates associated with groundwater at both Pocatello and Conda is related to phosphate processing operations. This is especially true for Pocatello, where some wells which would appear to be upgradient (in the groundwater aquifer) from processing plants are high in nitrate.

Excessive concentrations of phosphate, another important nutrient, can degrade streams and especially impounded water bodies. Concentrations in most water of the study area are generally only a few one-hundredths of a ppm (as PO_4). The pH and high calcium concentrations of the regional water helps maintain low concentrations of phosphate and fluoride by solid phases owing to precipitation of fluorapatite. However, sediments from the mine-disturbed land are likely to contain phosphate particulates. If the solubility reaction of fluorapatite in water is thermodynamically reversible, the solid fluorapatite would provide a small but continuous source of phosphate ions to solution. As phosphate ions in the water are assimilated by the biota, the law of mass action requires that more phosphate ions be released from solid to solution.

It is uncertain whether increased mining would greatly increase overproduction in waters of the area because natural erosion of the Phosphoria outcrops already supplies large amounts of sediment. However, during mining, the rock is broken up, and the finely divided material provides fresh surfaces of greatly increased area. The larger number of reaction sites thus exposed to the water allows more ions to be dissolved in a dynamic water system.

Presumably, the low solubility of florapatite also keeps concentrations of fluoride low, except in certain industrial waste ponds. Mining will probably not appreciably increase fluoride concentrations, but processing operations can release hazardous gases, including those containing fluorine, which in the past have caused local air-pollution problems within 2 or 3 miles of the plants. Such emissions probably do not seriously threaten water quality, but not enough data are available to evalute this.

The Phosphoria contains considerable organic matter, and such sediments, deposited in water bodies during mining, could produce anaerobic conditions, which, in turn, would lower the oxygen content of the water.

Improper handling of waste oil and fuel, used for mining and transportation machinery, could seriously impact water quality of streams; events of this type have been documented in Angus Creek.

Another potential impact is the possible failure of water and sediment control devices as a result of either inadequate design or unusual event. Risks inherent in design criteria can be evaluated; risks inherent in design based upon limited or inadequate data cannot. Inasmuch as detected hydrologic data upon which to base engineering designs are limited, the risk of underdesign is present. Failure of the underdesigned structures will release sediment laden waters to the stream systems below the water-control structure.

Based upon a more probable level of mining as shown in table 1-1a, impact on chemical water quality would be reduced, and those related to sediment modified. The severity of chemical water quality impacts may be reduced proportionally for those constituents not controlled by pH, temperature, solubility and adsorption rather than the amount of mine wastes subject to leaching. For more soluble elements, the concentration levels in both ground and surface water will be related to the extent of mining. Reduced levels of mining will likely result in lower sediment concentrations and hence lower total trace metal concentrations, particularly if the sediment were derived from mine waste.

Sediment levels would change appreciably. Because of the scheduling of the mining operations the Little Blackfoot River could experience an additional increase in sediment of about 15 percent over the same period of time. Trail creek will experience a reduction of about 40 percent from that previously estimated, but for longer duration. There will be some increase in Slug Creek and Upper Dry Valley but for shorter duration. For Maybe Creek, long-term impacts will likely be less, but of longer duration. Those in Upper Angus Creek will increase by about 30 percent. Impacts to Goodheart Creek, Dry Basin Creek, lower Angus Creek, Sheep Creek, and Lanes Creek will be about the same.

With the elimination of the Husky No. 1 mine and the revision of the Diamond Creek mining plan, sediment impacts to Diamond Creek will be reduced to one-tenth of the original estimate, from a five-fold (500 percent) increase to a 50 percent increase.

The combined effect on the Blackfoot River above the Blackfoot Narrows will be a significant reduction of sediment loads.

c. Water Use

The increased mining and processing of phosphate rock in the southeast Idaho phosphate region will create increased demand for water supplies for municipal and industrial use. The increased demand for use in actual removal of the phosphate rock at most sites will be small. Water is used at present at the mining sites mostly for dust control in the dry summer and fall months. The quantity used is reported by various companies to range from 20,000 to as much as 75,000 gpd per million tons of ore produced per year. Assuming that the average maximum use is 45,000 gpd (about 0.14 acre-feet) per million tons of ore produced annually, for 120 days a year, the greatest use of water for mining will be in the period 1980-85. The projected annual use during this period is 238 acre-feet. This does not include water that might be used for planned beneficiating plants in the mining areas.

Slurry transport of ore has been suggested by some companies as an alternate mode of transport. Normal slurry for pipeline transport contains 40- to 50-percent water by weight. Assuming a slurry of 45-percent water and 11-percent water in the ore as mined, 1 million dry tons of ore would require about 515 acre-feet of water to form the desired slurry. Because much of the water could be recycled, water requirements, however, would be minimal. If the water is not recycled, use of additional water in processing would be minimized and these water requirements reduced accordingly.

The population increase related to the phosphate mining and processing industry, and satellite industries, in the eight southeast Idaho counties most directly affected is projected to be about 22,300 people by the year 2000. Based on a percapita use of 280 gallons per day, which is about that now used in both Soda Springs and Pocatello, municipal water demand due to the growth of the phosphate industry will be about 6.2 million gallons per day (7,000 acre-feet per year) by the year 2000. This would be less if a considerable part of the new housing consisted of mobile-homes and multiple family units.

Of this, the demand in Caribou County will be about 4,000 acre-feet per year; in Bear Lake County, about 1,550 acre-feet per year; and in Bannock county, about 1,450 acre-feet per year.

Water consumption at the processing plants will increase commensurately with increased production. The present (1975) combined use in beneficiating and processing plants in the Conda-Soda Springs area is 5.58 mgd (6,250 acre-feet per year); and in Pocatello, 10.9 mgd (12,200 acre-feet per year). Assuming a direct relationship between water use and production, a projected four-fold increase in production would require a water supply of as much as 66 mgd (74,000 acre-feet per year); however, improved conservation measures and improved technology may reduce this considerably. A considerable part of this water would be used for proposed calcining and beneficiating plants in the mining area.

Electrical power consumption increase due to the increase in phosphate processing is projected to be 270 megawatts by the mid 1980's. The water requirements for producing this much power in an efficient water-cooled, fossil-fueled thermo-electric plant is about 4,000 acre-feet per year, based upon an assumed water requirment of 15 acre-ft per year per megawatt.

The expected increase in water use for both phosphate ore processing and municipal supplies probably can be met in the Pocatello area for the next two decades from ground-water sources in Michaud Flats and Gibson Terrace without mining ground water. The total increase in water use in the Pocatello area due to the phosphate industry will be about 30,000 acre-feet per year by the year 2000. Pumpage of this quantity of ground water would reduce the discharge of the springs along the lower reaches of the Portneuf River and would cause some lowering of ground-water levels.

The increased demand for water related to the phosphate industry--both for processing the ore and the associated population growth--would have a significant impact on the ground-water system in the Soda Creek drainage basin, if ground water were used. The estimated yield of Soda Creek near Soda Springs is 44,500 acre-feet per year. The maximum demand for water in the Soda Springs area, assuming a four-fold increase in phosphate production, with associated increase in processing (including beneficiating, calcining, thermal reduction, and fertilizer production) near Soda Springs, could be as much as 30,000 acre-feet per year. This much water could be withdrawn from the ground-water system underlying the Soda Creek drainage basin without mining water, but it would seriously reduce the flow of Soda Creek and the available water supply in the Bear River system, and would induce more leakage from Blackfoot River Reservoir.

Based upon a more probable level of mining as shown in table 1-1a, the total increase in water consumption due to the increase in population attributible to expansion of the phosphate industry, and to growth of the industry itself, will be about 22,500 acre feet per year in each of the Soda Springs and Pocatello areas by the year 2000. Municipal demand will increase by 530 acre feet in Bannock County, 470 acre feet in Bear Lake County and 1,035 acre feet in Caribou County by the year 2000, based upon estimated population increase attributable to the phosphate industry and the present percapita water use of 280 gallons per day.

Water use for mining, mainly for dust control and sanitary facilities at minesites, would be somewhat reduced.

3. AIR RESOURCES

The results computed, and the conlcusion and recommendations reached from these results, are based on existing emission data provided by the Environmental Services Division of the Idaho Department of Health and Welfare, and the production tonnage for current and future phosphate processing plants provided by the Interagency Task Force. Linking production to emissions data, and using this index for assessing future emissions from current and future processing plants was also necessary. No attempt was made to modify any results due to prospective increases in efficiency of any pollution abatement methods or requirements of any regulations.

Under the "Prevention of Significant Air Quality Deterioration (PSD)", sources are reviewed to determine whether an applicable air quality increment will be violated. The PSD increments are increases in air contaminant concentrations allowed after January 1, 1975. All increased total suspended particulate (TSP) and sulfur dioxide (SO_2) emissions occurring after that date contribute to the use of the increment. PSD regulations apply to phosphate rock processing plants and sulfuric acid plants, the construction or modification of which was commenced at any time after June 1975. For southeast Idaho, at present new or modified stationary sources may not violate the Class II increments listed in 40 CFR 52.21 for particulate matter and sulfur dioxide.

Based upon mining plans as originally submitted and the indicated plant expansions, the primary impact on air quality attributable to the development of phosphate resources in southeastern Idaho would be from the growth of the existing plants. The additional five plants scheduled during the next two decades, with one exception, are expected to exceed any of the primary or secondary ambient air quality standards for SO_2, particulate or fluoride as well as the Class I and II PSD Standards. The exception is the Beker Georgetown plant which is calculated to exceed the EPA Class I PSD allowable increase according to the 1985 and 1995 computations if reactivated. Results of modeling of the air quality are presented in tables 1-37 to 1-42.

The data, based upon simple projections, for both existing fertilizer plants, Simplot at Pocatello and Beker at Conda, would exceed

Table 1-38.--Projected maximum monthly average ambient concentrations of fluorine, (in parts per million), resulting from various sources in Pocatello and Conda-Soda Springs, July 1985 and July 1995

Source	1985	1995
POCATELLO		
Simplot stack	1.19×10^{-3}	1.19×10^{-3}
Simplot pond	9.22×10^{-2}	9.22×10^{-2}
FMC	1.86×10^{-4}	2.26×10^{-4}
Maximum all sources	9.22×10^{-2}	9.22×10^{-2}
CONDA-SODA SPRINGS		
Beker (Conda) stack	1.00×10^{-3}	1.00×10^{-3}
Beker (Conda) pond	4.18×10^{-2}	4.18×10^{-2}
Monsanto	8.33×10^{-4}	2.11×10^{-3}
Beker-Georgetown	5.99×10^{-5}	5.99×10^{-5}
Maximum all sources	4.18×10^{-2}	4.18×10^{-2}

Table 1-39.--Projected maximum monthly average ambient concentrations of fluorine, (in parts per million), resulting from various sources in Pocatello and Conda-Soda Springs, August 1985 and August 1995

Source	1985	1995
POCATELLO		
Simplot stack	1.11×10^{-3}	1.11×10^{-3}
Simplot pond	9.66×10^{-2}	9.66×10^{-2}
FMC	1.79×10^{-4}	2.17×10^{-4}
Maximum all sources	9.66×10^{-2}	9.66×10^{-2}
CONDA-SODA SPRINGS		
Beker (Conda) stack	9.40×10^{-4}	9.40×10^{-4}
Beker (Conda) pond	4.17×10^{-2}	4.17×10^{-2}
Monsanto	8.74×10^{-4}	2.21×10^{-3}
Beker-Georgetown	5.20×10^{-5}	5.20×10^{-5}
Maximum all sources	4.17×10^{-2}	4.17×10^{-2}

Table 1-40.--Projected maximum 24-hour ambient concentrations of particulate (in micrograms per cubic metre), and SO_2 (in parts per million), relative to distances from phosphate-processing plants, 1985 and 1995

Plant	1985		1995	
	Maximum concentration	Distance (miles)	Maximum concentration	Distance (miles)
	PARTICULATES			
Simplot (Pocatello)	27.2	1.6	27.2	1.6
FMC (Pocatello)--stack	16.8	1.6	30.0	1.6
FMC (Pocatello)--fugitive	471	.6	555	1.6
Beker (Conda)	16.2	1.6	16.2	1.6
Simplot (Conda)	12.9	1.6	12.9	1.6
Monsanto (Soda Springs)--fugitive	29.3	.6	72.9	.6
Monsanto (Soda Springs)--stack	3.2	1.6	7.8	1.6
Earth Sciences (Bloomington)	4.84	1.6	4.84	1.6
Beker (Georgetown)--fugitive	10.6	.6	10.6	.6
Beker (Georgetown)--stack	0.78	1.6	0.78	1.6
Alumet (Diamond Creek)	8.07	1.6	8.07	1.6
FMC (Dry Valley)	2.84	1.6	2.84	1.6
IMC (China Hat)	9.68	1.6	9.68	1.6
	SO_2			
Simplot (Pocatello)	0.158	1.6	0.158	1.6
Beker (Conda)	0.085	1.6	0.085	1.6

Table 1-41.--Violations of EPA and State of Idaho ambient air quality standards based on calculated maximum values - 1995

	Particulates				Sulfur Dioxide					
	Annual		24-Hr		Annual		24-Hr		3-Hr	
	I	II	I	II	I	II	I	II	I	II
FMC Pocatello	E	E	E	E	-	-	-	-	-	-
Simplot Pocatello	X	-	X	-	E	E	E	E	E	E
Monsanto Soda Springs	X	X	X	X	-	-	-	-	-	-
Beker Conda	X	-	X	-	E	E	E	E	E	E
Simplot Conda	X	-	X	-	-	-	-	-	-	-
Earth Sciences Bloomington	-	-	-	-	-	-	-	-	-	-
Beker Georgetown	X	-	X	-	-	-	-	-	-	-
Alumet Diamond Creek	-	-	-	-	-	-	-	-	-	-
FMC Dry Valley	-	-	-	-	-	-	-	-	-	-
IMC China Hat	-	-	-	-	-	-	-	-	-	-

"E" indicates in excess of primary and/or secondary ambient air quality standards in 1975 and thus not included under PSD.
"X" indicates in excess of PSD standards.

Table 1-42.--Violations of EPA and State of Idaho ambient air quality standards based on calculated maximum values - 1985

	Particulates				Sulfur Dioxide					
	Annual		24-Hr		Annual		24-Hr		3-Hr	
	I	II	I	II	I	II	I	II	I	II
FMC Pocatello	E	E	E	E	-	-	-	-	-	-
Simplot Pocatello	X	-	X	-	E	E	E	E	E	E
Monsanto Soda Springs	X	X	X	-	-	-	-	-	-	-
Beker Conda	X	-	X	-	E	E	E	E	E	E
Simplot Conda	X	-	X	-	-	-	-	-	-	-
Earth Sciences Bloomington	-	-	-	-	-	-	-	-	-	-
Beker Georgetown	-	-	X	-	-	-	-	-	-	-
Alumet Diamond Creek	-	-	-	-	-	-	-	-	-	-
FMC Dry Valley	-	-	-	-	-	-	-	-	-	-
IMC China Hat	-	-	-	-	-	-	-	-	-	-

"E" indicates in excess of primary and/or secondary ambient air quality standards in 1975 and thus not included under PSD.
"X" indicates in excess of PSD standards.

the primary and/or secondary ambient air quality standards for SO_2 for 1985 and 1995. Both plants would significantly contribute to vegetation which exceeds the existing fluoride standards, owing primarily to emission from settling ponds. FMC's elemental-phosphorus plant at Pocatello would exceed the primary and secondary ambient air quality standards for particulates during both time periods, while during the 1995 period, the Monsanto plant would just about equal the PSD standard for particulates and could possibly exceed it for 24 hour, Class II, depending on the accuracy of the available calculations.

The ambient concentrations of SO_2 from the two fertilizer plants, were computed by two different techniques. The data indicate that for the periods 1985-95, the Simplot plant would exceed the established standards under the stagnation-persistence technique.

Onsite mining impacts will be largely from fugitive dust as a result of mining procedures and equipment operations. Uncontrolled particulate emissions from phosphate mining are estimated at 0.5 pounds per ton. Maximum concentrations would likely occur on dry, windy days in July and August.

4. VEGETATION

Based upon mining plans as originally submitted, major impacts will be from disturbance of vegetation by mining activities and facilities on 8,900 acres. Approximately 53 percent is in the sagebrush-grass cover type, 39 percent in the conifer-aspen cover type, 3 percent in agricultural lands, and 3 percent in the mountain-brush, riparian, and marshland cover types. Forage production of these cover types range from a low of 400 to a high of 2,300 pounds of air dry weight per acre, with the average being 500 to 1,800 pounds of air dry weight per acre. Some 1,500 acres of timber will be removed. Most of the timber is highly scattered and is considered uneconomical as timber management areas. Lesser impacts will be caused by fugitive dust and airborne pollutants being deposited from haul roads, waste dumps, and processing plants. This could affect plant vigor, and plants may be less palatable and possibly harmful to livestock and wildlife. Damage from these types of pollutants, especially from processing-plant emissions, can be significant. The effect of dust and vehicle emissions at the minesites, however, will be minimal.

Analyses of plant materials made by the U.S. Geological Survey for the task force showed that concentrations of nine trace elements (cadmium, chromium, fluorine, lithium, nickel, selenium, uranium, vanadium, and zinc) increase in tissues of either sagebrush or grass as the processing plants at Pocatello or Soda Springs are approached. Concentrations of these elements within 1 mile of the processing plants are typically about nine times their concentrations 30 miles from the plants. The concentrations of fluorine and vanadium in sagebrush near the plants are more than 50 times their concentrations at 30 miles.

The observed concentrations are judged to be unusually high for all nine elements in both sagebrush and grass within 0.5 to 1 mile of the plant; for cadmium, chromium, lithium, nickel, uranium, and vanadium in sagebrush within 6 miles of the Pocatello plant; for cadmium, chromium, uranium, vanadium, and zinc in grass within 6 miles of the Soda Springs plant.

Cadmium, chromium, lithium, nickel, and zinc may interfere with vegetative health at elevated levels, and chromium, fluorine, nickel, selenium, vanadium, and zinc are known, or suspected, to occur in forms that can be assimilated by animals or humans.

Fluorine concentrations measured in grass within 2 miles of the processing plants at both Pocatello and Soda Springs ranged from 50 to 220 ppm; in sage, they ranged from 170 to 1,100 ppm. Idaho air-quality standards specify that the concentration of fluorine in the air must not result in a total fluoride concentration in feed and forage of more than 80 ppm (dry weight) for up to a month, 60 ppm per month for two consecutive months, or 40 ppm annual arithmetic mean.

Soil and water relationships will be altered by the mining activities. This change in moisture relation will change vegetation types or compositions both on and off the mining sites. Draws being filled with waste material will alter the amount of moisture that normally drains to the center of draws and thus change the amount of moisture available to plantlife in the valley bottoms. Generally speaking, areas that receive increased moisture might develop more water-tolerant vegetation (sedges, rushes, and cattails), and those areas receiving less moisture will develop a drier type vegetation (sagebrush, and rabbitbrush).

Effect on vegetation is expected to be minimal from dust and vehicle exhaust.

To date, vegetal degradation due to air pollutants has been small (Georgetown Canyon). It could become a noticeable effect if air standards are not met.

Fire is not expected to be a significant impact due to increased access, existing climate, and prevention measures.

Based upon a more probable level of mining, as shown in table 1-1a, a total of 4,159 acres of vegetation will be removed or disturbed. Of this amount 2,634 acres will be reclaimed.

5. WILDLIFE

Based upon mining plans as originally submitted, the proposed mining and processing activities and the attendant transportation will have severe impacts upon the wildlife in the study area.

The life systems of big-game, such as elk, deer, and moose, will be disrupted as a result of the mining activities. The major areas of impact will be in the State of Idaho Fish and Game Management Units No. 76, 66, 66A, 69, and 78. Mining will require the removal of vegetation, topsoil, and overburden materials above the phosphate ore. The removal of this food and cover and the presence of mining activities will produce a series of negative impacts to the life systems of the big-game species. Some of these effects may be temporary, and some may have long-lasting consequences.

Loss of food and cover and disturbance will cause a displacement of these large animals. Survival of displaced animals will be dependent upon their ability to adapt and the carrying capacity of ranges to which they move.

The productivity of the elk herd will be affected by disrupting major calving areas. The total impacts on numbers and time periods for relocation and possible adaptation are unknown. Recent studies in timber sale areas indicate that elk strongly prefer to remain at least one-half mile from people engaged in vehicle, or out-of-vehicle, activities. However, elk have been observed at and near present mines.

Several major migration routes for deer and elk will be disrupted as a result of highwalls, and transportation systems. The ability of these species to relocate and survive is unknown. It can be expected that road kills will increase with increased vehicular traffic.

Increases in human activity will affect each of the big-game species to varying degrees. Elk, deer, moose, black bear, and mountain lion are very sensitive to man's activities. Increased disturbance can be expected in response to increased human activity and overall population increase. An estimated 20,000 acres of habitat within the study area are essential to the year-around activities of the elk herd in Unit No. 76, including calving grounds, feeding areas, migration routes, and important cover for security and wintering area. The Idaho Fish and Game Department estimates that about 750 elk will be affected by mining and the rest of the herd will be affected by this disturbance, including important calving grounds and wintering areas, two of the limiting factors on this elk herd. Idaho Fish and Game assumes that since the area is presently stocked with the desirable number of elk, relative to the carrying capacity of the land, loss of this habitat will result in an estimated 50 percent reduction of the estimated 750 elk in Herd Unit No. 76. The elk population of unit 76 represents approximately 80% of the elk that will be affected by phosphate development in the southeastern region of the Idaho Fish and Game Department.

Hunting success for elk and moose indicates that the majority of the elk and moose populations for Unit 76 are in the project area. The elk permits and 18 moose permits provide a significant portion of southeast Idaho elk and moose hunting opportunity. Mining activities and pressures from the greatly expanding human population in the area will reduce the present quality hunting in the unit.

Estimated Number of Elk Lost	Estimated Number of Cows Lost	Average Number of Calves per Cow	Normal Level of Harvest	Estimated Calves Produced	Estimated Annual Harvest Lost
375	180	.50	14%	90	52

The wintering mule deer in the study area, estimated at 16,000 by the Idaho Fish and Game Department, will be directly or indirectly impacted by mining and by human disturbance resulting from pressures from increased human populations. Direct impacts are loss of critical winter range, blocking of migration routes, and loss of intermediate and summer range. The loss of winter range and blocking of migration routes will have significant long-term impacts.

The major indirect impact is the overgrazing of ranges by deer forced to seek new ranges which are now at or just below carrying capacity. Again, critical winter ranges will receive the greatest impact. The Idaho Fish and Game Department estimates that initially as many as 3,000 wintering deer could be lost. The initial effects are seen in the following table, which shows the estimated annual harvest loss in the study area:

Estimated Number of Deer Lost	Estimated Number of Does Lost	Average Number of Fawn Per Doe	Normal Level of Harvest	Estimated Fawn Produced	Estimated Annual Harvest Lost
3,000	1,310	.91	26%	1,192	780

The direct loss of 3,000 deer, as seen above, may ultimately reduce the harvest of deer by approximately 19,500 over a 25 year period. This estimated loss is based on existing sex ratios, expected progeny, life expectancies and hunting harvests of a normal population of 3,000 deer.

These calculations of the losses of harvestable deer and elk do not take into account the fact that mining activities will occur over a period of time rather than be instantaneously conducted and that all of the proposed mines described here will go into operation. The actual losses will depend upon the rate at which mining will occur as well as the number of mines which go into production.

Moose, cougar and bear populations will be reduced by an unquantifiable amount.

Sage grouse will be impacted by loss of 7 of 10 known critical winter ranges, 3 of 7 known historic strutting grounds, 10 of 13 known critical brood-rearing areas, and 4 of 7 known nesting sites. Human disturbance, roadkills, and increased poaching will be the major responsible factors.

Many of the populations whose total life requirements are found within a drainage or canyon could be displaced. Alteration of any one of the critical habitat components will result in the birds failing to winter over, to return to historic strutting grounds, and to nest or raise young. Again, the cumulative effect is significant. For example, if winter range is altered for 300 sage grouse, (a conservative estimate) half--150 hens--would be effected. On the basis of the average young per hen of 4.4 in the study area, the total annual impact will be loss of 660 offspring available for hunting and recruitment into the existing populations.

The Columbian sharp-tailed grouse was classified "status undetermined" by the U.S. Fish and Wildlife Service, indicating that it was in serious trouble. Therefore, the alteration of any additional habitat in the study area could result in the population or populations within the study area becoming endangered. As noted for sage grouse, impacts resulting from the alteration of winter range, traditional dancing grounds, and nesting or brood-rearing habitats will be significant. The degree of impact at this time cannot be determined as many of these habitat areas for sharp-tails are unknown.

Mining will create major impacts on the mating, nesting, brood-rearing, and wintering habitat of ruffed and blue grouse. Impacts will mainly occur from alteration of habitat. Approximately 3,500 acres of suitable grouse habitat will be altered, including such important areas as Dry Valley Ridge and Rasmussen Ridge. On the basis of estimates of 1.9 acres per grouse, there is an expected loss of 1,840 forest grouse per year.

The largest coveys of Hungarian partridge occur where sagebrush-grass habitats are located adjacent to farmland. These are also major haul roads and railroad development areas. Thus, impacts to the "Huns" populations could be extremely high. Mourning doves occur throughout the study area from the valley bottoms to the coniferous-deciduous zone. Five areas of excellent mourning dove habitat and 7 areas of good habitat will be impacted. As there are no base data, such as average nesting pairs per acre in the various habitats, no estimation of the impacts to the mourning dove population can be calculated. The chukar population in the study area is located on and adjacent to Dingle Ridge, where no current mining plans are proposed. Pheasants will be affected by increased hunting pressure even though their populations are extremely limited in the study area, and for the most part they occur on private property outside the phosphate mining impact areas.

Cottontail and pygmy rabbits will also be significantly reduced directly, because of loss of habitat and, indirectly, by increased hunting pressure facilitated by road construction into areas where few and/or poorly developed roads occur presently.

Impacts to the red squirrel will mainly result owing to loss of habitat. The red squirrel is dependent upon mature conifer trees for food supply. Where these trees are removed, the squirrel will be displaced. Individual mine locations, such as the Wooley Valley mine, will result in a total loss of red squirrel habitat in the upper portions of the Angus Creek drainage. The impacts on the total red squirrel population will result in a reduction of squirrel numbers, but the magnitude should affect less than 25 percent of the squirrel populations in the project area.

There are 31 waterfowl species in the study area. The impact to waterfowl will come in two forms, onsite and offsite. Onsite impacts are nesting and brood rearing habitat destruction--primarily from road and railroad construction, abandonment of nesting and brood-rearing habitat because of human disturbance associated with roads and railroad construction, and use and loss of winter feeding areas--particularly in existing dryland farming areas. Offsite impacts are alteration of suitable nesting, brood-rearing and migratory-concentration areas, and increased human disturbance.

Mallards, pintails, and green-wing teal mainly will be affected. No qualitative or quantitative baseline data are available from which estimates can be drawn. Significant waterfowl areas that will be impacted include Diamond Creek, Chicken Creek, Yellowjacket Creek, Swan Lake Gulch, Slug Creek, Wooley Valley, Dry Valley, Woodall Marsh, and the Blackfoot River. Greatest offsite impacts for waterfowl will be in the Blackfoot River, Bear River, Diamond Creek, Blackfoot River Reservoir, Grays Lake, and Dingle Marsh areas, where over 1 million ducks migrate each year.

Several known Canada geese production areas will be affected: Woodall Marsh, Blackfoot River, Diamond Creek, Slug Creek, Lanes Creek, and Soda Springs to Blackfoot River Road.

The trumpeter swan only recently began to re-establish itself in its former habitats. The proposed mining and increased human disturbance will preclude any possibilities of trumpeter swans re-establishing themselves in the Diamond Creek, Swan Lake Gulch, Slug Creek, and Woodall Marsh areas which appear to be suitable habitats. Offsite adverse impacts to some of the trumpeter swans nesting in Grays Lake National Wildlife Refuge could result. Migrating trumpeter and whistling swans could be similarly affected.

Beaver, marten, and Canada lynx will be disrupted. Impacts will be greatest on beaver, owing to the restricted environment of beaver, and will mainly occur through loss of habitat. Impacts to marten and Canada lynx will be mainly due to human disturbance and reduction in food supply. Individual sites, such as Yellowjacket Creek and portions of Diamond Creek, will be destroyed for beaver, and the total beaver habitat in the project area will be significantly affected by mining and the associated transportation network and human disturbances.

Except for house mice and Norway rats that could expand their range, the rodent and lagamorph populations in all habitat types will be adversely affected, resulting in reduced prey species for predators. Mammalian predators, such as bobcats and coyotes, can be expected to seek alternate food sources with increased depredation of livestock, particularly sheep and cattle. Other mammalian species, the shorttail and longtail weasel, badger, fox, and spotted and striped skunks will also be reduced.

Several golden eagle nesting sites will probably be abandoned owing to habitat loss, increased human activity, or lowered prey populations. The development of powerlines also poses a major threat to both bald and golden eagles from electrocution if structures are not properly designed. The net result will likely be a lowering of the total golden eagle population within the study area. Prairie falcons, ferruginous hawks, pigeon hawks, and burrowing owls will also be affected. Reduction of suitable habitat and disturbances by increased human activity could result in further pressures on those species listed as "threatened" or "endangered" or which now exist in very low numbers. A traditional bald eagle aerie in Middle Sulphur Canyon could be disrupted or destroyed.

The greater sandhill crane was recently removed from the threatened species list as it has shown a remarkable recovery in recent years, particularly in the study area. Known nesting, brood-rearing, and feeding areas for sandhill crane will be altered throughout the study area. Other such areas could be affected. Offsite impacts pose the greatest threat to the total crane population. Depending upon the degree of impacts, the greater sandhill crane population could become threatened or endangered within the study area.

Most of the 184 species of songbirds and insectivorous birds which inhabit the study area will suffer loss of habitat, thus reduced populations. None of the songbirds and insectivorous birds within the study area are classified as endangered, threatened, or status undetermined. However, reduction of this segment of the animal community will adversely affect raptorial species such as the peregrine falcon, Cooper's hawk, sharp-shinned hawk, and the goshawk. The greatest impacts to the songbird and insectivorous bird populations will occur wherever various habitats are destroyed or altered.

Little or no data are available on amphibians and reptiles. Loss of habitats for these species will adversely affect, directly or indirectly, other wildlife in the study area. Amphibians and reptiles are the least adaptable; their habitat requirements are very precise. Loss of any dryland habitat, riparian, marshland, and aquatic communities will result in the reduction and in some instances the loss of amphibian and reptilian animal communities in some localities.

At a more probable level of mining of 15 million tons by the year 2000, as shown in table 1-1a, there will be a significant reduction in impacts to wildlife. About 12,500 acres of habitat instead of 20,000 acres will be affected. About 200 elk will be impacted, instead of the estimated 375 at the originally-proposed mining levels, about 2,300 deer instead of 3,000 deer, and perhaps about 5 fewer moose. Impacts to waterfowl will be reduced about 60 percent. Impacts to sage grouse will be reduced about 50 percent, and about 1,500 instead of 1,840 forest grouse will be affected. Only 5 instead of 10 areas of good mourning dove habitat will be impacted. The projected impacts on the sandhill cranes would be lessened in the Woodall Marsh, Slug Creek, and Swan Lake areas.

THREATENED AND ENDANGERED SPECIES

Recent sightings of peregrine falcons in separate locations indicate that as many as four pair may frequent the study area. The nesting success of these birds is not known. There is a migration corridor that these birds follow during their winter migration periods, and this route passes through the northern part of the study area. The peregrine falcon are known to winter in the study area. None of the proposed mining activity will destroy any known nesting aeries, with the possible exception of Middle Sulphur Canyon; however, some mining activity will occur within the hunting range of known peregrine nesting aeries, resulting in adverse impacts to peregrines by alteration of available prey-species habitat. Such impacts will occur in Woodall Marsh and the Blackfoot River areas, where riparian wildlife species, songbirds and insectivorous birds, shore birds, and waterfowl populations will be reduced. The peregrine falcon is sensitive to human disturbance during courtship and nesting periods in late winter and early spring. Thus, existing nesting sites could be abandoned.

Whooping cranes were introduced in the study area in 1975. Existing suitable habitat for the successful establishment of whooping cranes will become unsuitable after the proposed mining and associated developments take place. Important areas that will be affected are the Blackfoot River and associated marshes, Lanes Creek, Diamond Creek, Rasmussen Valley, Slug Creek, Dry Valley, and Woodall Marsh. The likely habitat remaining undisturbed for them would be that associated with the Grays Lake National Wildlife Refuge.

At a more probable level of mining, as shown in table 1-1a, the impacts to Woodall Marsh would not occur, and those to Slug Creek would be reduced.

The rest of the species listed in Chapter II have been observed or are thought to inhabit the region. However, since there are no specific on occurrences or habitat, specific impact cannot be assessed.

6. FISHERIES

Because only a few aquatic environments and their fisheries have been studied in detail, full evaluation of the impacts on these fisheries is not possible. Therefore it is necessary to use qualitative rather than quantitative terms to describe the impacts from the mining. In order to reduce any confusion caused by using these qualitative terms, we are including the following definitions from Webster's New

Collegiate Dictionary, 1975 edition:

low	of lesser degree, size, or amount than average or ordinary
moderate	tending towards the mean or average amount of dimension
high	of greater degree, amount, cost, value, or content than average, usual, or expected
severe	of a great degree, marked, serious
Stress	a physical, chemical, or emotional factor that causes bodily or mental tension and may be a factor in disease causation

Based upon the mining plans as originally submitted, the impacts from proposed mining activities will be concentrated mainly in the Blackfoot River and Bear River drainages, but other drainages will be impacted increasingly with time.

Increased sediment-transport rates are harmful to aquatic life, especially if some deposition of sediment on the streambed occurs. For example, diversity indices of benthic invertebrates may or may not be reduced, but species compositions of benthic invertebrate assemblages are likely to change to smaller organisms specifically adapted to fine-grained bottom material. The larger organisms that are usually the preferred fish food organisms will probably be greatly reduced in number.

Mechanical or abrasive action of suspended sediment may directly and indirectly affect fish by clogging their gills and impairing their respiratory and excretory functions. Accelerated sediment transport will increase egg mortality and reduce rearing potential. Blanketing of plants and sessile animals, as well as important habitats such as spawning sites, may cause drastic changes in aquatic systems. Data from EPA suggest that concentrations of even inert suspended solids at sustained levels of 25 to 80 ppm may begin to affect the yield of fish, and that water containing sustained sediment concentrationss of 80 to 400 ppm is unlikely to support good fisheries.

Within the Bear River drainage system, the underground mine at Paris-Bloomington could affect Paris and Bloomington Creeks, both of which support a rainbow and brook trout fishery. Because of limited space within the canyons, water discharged from the mining operation could carry toxic substances into the streams. Adits and stopes may collect toxic waters and discharge them out the portal, thereby causing polluted water to enter the streams over a long period of time. If the wastes can be stored in underground stopes and adits, as proposed by the mining company, and mine waters do not enter the stream, impacts from the mining operation could be minor. However, increased sediment loads caused by transportation improvements could impact on the fisheries.

In the past, mining, processing operations, and stream channel alterations eliminated most of the trout in Georgetown Creek below the processing plant. Since the operations have ceased, trout populations have become reestablished. Because Georgetown Canyon is narrow, installation of effective pollution-abatement facilities is hampered; therefore, resumption of mining and milling activities will eliminate the Georgetown Creek fishery, below the minesite.

Impacts of the proposed mining in Swan Lake Gulch on the existing fisheries in the area would be indirect, because the site is not adjacent to a perennial water source. However, turbid surface water could enter Swan Lake, with degrading effects. The increased turbidity could result from proposed debris basins, from airborne particulate matter from disturbed areas, and from mining and transportation activities. Swan Lake is stocked annually with rainbow trout. Swan Reservoir, only about 3 feet deep, does not support a fishery, although a sucker population survives there. Swan Creek does not support a salmonid population.

Because the minesites at North Trail Canyon and Middle Sulphur Canyon are not near perennial surface waters, they will have no direct effect on fishery resources. Surface water from storms or snowmelt could reach Bear River, but impacts would be minor. The transportation system in this area should have no effect upon the aquatic environment.

The Blackfoot River drainage system supports the main fishery in southeastern Idaho. Trout populations of Blackfoot River Reservoir are dependent on a number of impacted streams of the drainage for reproductive and nursery purposes, with the most important being Sheep and Spring creeks. The stress in some Blackfoot River tributaries from future mining activities would be very high, with the accumulated stress in the Blackfoot River and Blackfoot River Reservoir high.

Lanes Creek, a high-quality fishery, will receive high stress from mining. Spring Creek and Sheep Creek will receive moderate stress. All these are significant cutthroat trout spawning areas. Diamond Creek and Lanes Creek are high-quality streams, which support a good cutthroat-trout fishery as well as other nongame fish species. The Diamond Creek mining plans call for returning any perennial stream water used in mine operations to the natural drainage immediately downstream. This water may be high in total solids. Decanted water from settling ponds will be held up to 60 hours, which could mean that turbid waters will be released into the stream. Also, large amounts of subsurface water (1,670 gpm per 1,000-feet panel) will be pumped and contained; the efficiency with which this operation is managed will determine the extent of degradation to the receiving stream. An onsite calcining plant could add significantly to the impacts on the fishery. The proposed railway construction and/or highway improvement through the Blackfoot Narrows to reach the Lanes Creek and Diamond Creek mines would severely injure the Blackfoot Narrows fishery during construction. According to the Idaho Fish and Game Department, the altered channel would support only one-eighth the number of fish per unit of length than a natural channel, with the reduction lasting 90 years or more. An alternative route north of this area would have considerably less impact on fisheries.

The small, limited fishery in Maybe Creek will probably be eliminated by expanded mining operations proposed by Beker Industries. The fishery is minor and is now rated low because of past degradation by mining and livestock.

The proposed Champ and Mountain Fuel mines are not near perennial water sources, and surface waters from the mining areas that reach a major offsite water system are negligible. Therefore, impacts would be minimal.

The Dry Valley minesite has no fisheries, so the mine proposed by FMC Corporation will have no degrading impact on fishery resources. If a calcining plant is constructed near the mine, airborne materials, including fluorine, could be transported to waters supporting a fishery.

Impacts from the Husky No. 1 mine operation, proposed by IMC Corporation, will affect Maybe Creek and Diamond Creek, as well as the ephemeral South Fork and the perennial headwaters of Stewart Creek; some alteration of the latter two is already occurring. Ponds will be built to control excess sediment discharge, but the adequacy of these ponds cannot now be predicted. The open-pit mine and waste dumps will eliminate or will cover part of the streambed in upper Stewart Creek. Alternate dump B will cover 2 miles of perennial and intermittent stream in the middle Stewart Creek area, and alternate dump A spreads out over the upper Maybe Creek area, providing another source of sediment to that stream.

The Henry North continuation mine will disturb 225 acres within ½ mile of the Little Blackfoot River. A buildup of sediments in the stream and in Blackfoot River Reservoir could result from mining activities and additional road construction.

The Trail Creek minesite will be in ephemeral drainage within 1 mile of Slug Creek. Impacts should be negligible if stream-channel disturbances are minimized during possible construction of a railroad bridge across the creek.

Caldwell Canyon mining activities will be in ephemeral drainage ½ mile from Slug Creek. This slow, meandering stream would have difficulty carrying the accelerated sediment loads transported from the disturbed land by storm or snowmelt runoff. Proposed transportation, particularly by the railway, could add to the impact.

The Blackfoot Bridge minesite is not near a perennial stream, but surface waters draining from this area could enter the Blackfoot River, adding to the cumulative effects from other mines. The cumulative effect is expected to be moderate to high. The proposed transportation system should have no effects upon the aquatic resources.

Angus Creek has already been degraded by mining and livestock activities. Even with extra precautionary installations to reduce siltation, Wooley Valley Unit 3 mine will degrade Angus Creek further,

B. CULTURAL ENVIRONMENT

1. LAND USE

a. Land-Use Change

Based upon mining plans as originally submitted, land-use requirements, reflecting the amount and type of land disturbance associated with existing, expanded, and new phosphate-processing operations in southeastern Idaho, are summarized in table 1-2. Future requirements have been assumed by the Task Force on the basis of best available information. The averages are considered reasonable. The assumed locations of the four new beneficiation plants proposed for startup during 1977 or 1978 are shown in Chapter I. Because of high land values and other company considerations, final selections of precise plantsite locations within the specified areas have not been made by IMC or Earth Sciences.

The four new beneficiation plants will result in land use change to varying degrees, depending largely on the volume of ore processed, the type of washing-sizing method ultimately used, the corresponding fluidity of the resulting tailings, and the disposal area required. Present conventional methods produce a tailings slurry with only about 20- to 30-percent solids, and they require extensive tailings ponds. However, two new operators, Earth Sciences and Alumet, are experimenting with drying slurry (40- to 50-percent solids) and completely dry beneficiation methods, respectively. If these methods prove feasible and are adopted according to plan, the requirement for huge tailings ponds and the amount of total plant land area disturbed will correspondingly be greatly reduced.

As shown in table 1-2, with the application of dry-processing methods by Alumet, the requirement for tailings ponds would be reduced by 840 acres. In this case, the total beneficiation plant area will cover only 112 acres instead of 952 acres, and the plantsite will have no tailings ponds as required by conventional wet methods. Correspondingly, the application of drying slurry as proposed by one company would also reduce tailings pond requirements.

The amount of land disturbance and corresponding impacts also will vary substantially with the terrain available for tailing ponds and, therefore, will vary with the final plantsite selection. For example, an ore-processing capacity of 1.5 million tons per year requiring 5,000 acre-feet of tailing ponds for dry-slurry beneficiation over a 10-year period will disturb 500 acres to a depth of 10 feet on level land but only 25 acres to a depth of 200 feet (average) in a suitable dammed-off valley. However, in southeastern Idaho, tailing ponds over 50 feet deep probably are not feasible.

The impacts on both the natural and cultural environments also will vary considerably from one plantsite to another, depending largely on the types of lands involved, their land use patterns, and their proximity to important natural and cultural resources.

Precise impacts on land use and land ownership cannot be assessed until full details on plant locations, processes, and operations are available. However, on the basis of available company information, probable plantsite locations, and corresponding projections, some general land use estimates can be made. As outlined in the accompanying table, the total combined land disturbance of the six existing phosphate processing-plants is about 1,160 acres, all on privately owned land. With anticipated new and expanded plant facilities, this figure is projected to grow to an estimated 3,480 acres (a three-fold increase) by 1980 and to 4,420 acres (near a four-fold increase) by 1990. All phosphate processing plant operations and corresponding land disturbance will be on privately owned agricultural and range lands.

Further land use changes will occur as expanding populations move outward from existing population centers. These impacts are discussed more fully in the section on socioeconomics.

Based upon a more probable level of mining, as shown in table 1-1a, changes in land use would be drastically reduced. Conversion of about 2,700 acres for the IMC and FMC beneficiating plants will not occur. The requirements for about 2,400 acres for the Alumet beneficiating plant has been reduced to about 250 acres for the plantsite.

Conversion of land to residential use will also be substantially reduced because of reduced population projections, both for overall population and for that specifically associated with the phosphate industry.

b. Agriculture and Range

Based upon mining plans as originally submitted, traditional agriculture practices of the area will be primarily impacted by effects on irrigation waters, land values, labor markets, air quality, and soil fertility. Major impacts on the livestock industry include loss of forage, disruption of traditional grazing patterns, creation of physical hazards and barriers, depletion or relocation of watering facilities, increased theft, vandalism, and rustling in remote areas, and introduction of chemical pollutants, such as fluorine, to the air.

About 74,000 acre-feet of water will be required annually for phosphate processing. This, along with other demands for mining and municipal uses as previously identified, may require reallocation of irrigation water, the quality of which could be severely degraded by the introduction of sediments, nutrients, and toxic trace elements. Locally, alterations of flow patterns could directly affect the volume of water delivered to the current irrigation systems, although little water is used now for irrigation near the proposed minesites.

Higher land values, created by the increased demand for land for mining and processing and the attendant demands for urban and residential expansion, will inflate agricultural land values and probably increase taxes accordingly. Some farmers and ranchers could be forced to convert the land from agricultural to other uses because of the economic impacts imposed on them. By 1980, 522 acres of land may be needed to accommodate the anticipated growth; by the year 2000, 1,175 acres may be required.

Farm labor will be severely impacted, especially in the Soda Springs area. Traditionally, wages paid in the agricultural sector are lower than in industry. Unless farming operations are handled as a single-family enterprise, additional employees may be difficult to acquire. Furthermore, there will likely be a loss of farm labor to mining-related jobs.

The proposed mining operations will probably not affect the fertility of cropland. A positive impact will be the greater availability of phosphate fertilizers produced in the area for local farm consumption.

The cost per unit of this fertilizer may increase, however, if the total costs of extracting these minerals is greater than the costs for existing mines and facilities. But these costs may be less than if the area was not mined and phosphate from alternative sources was obtained.

About 8,900 acres will be subject to partial or total loss of forage during the 25-year period. Virtually all the 2,900 acres of pit area will be lost to livestock grazing. The success of revegetation efforts on the other impacted areas will determine the ultimate loss of livestock-grazing forage. It is estimated that total livestock forage losses from traditional ranges will be equivalent to 3,900 AUM annually. This loss of forage may be large enough that some operators will be forced out of business.

With the settlement of this area by livestock-oriented people, their traditional livestock operations, grazing systems, and grazing patterns have developed a fairly efficient use of rangeland. This has been accomplished by the initiative and financial capability of the operators in cooperation with, and through the direction of, the land-managing agencies. The open pits and dumps will impose hazards, obstacles, and inconveniences on the traditional migration routes, grazing systems, and operations. Some existing watering facilities will probably dry up or be altered. Consequently, operations and grazing systems will have to adapt to the new obstacles and problems or they will cease to exist.

Stockmen have expressed concern over the possibility of accidents or death losses as a result of manmade hazards associated with mining operations. These include highwalls, roads, fences, cattleguards, bog holes, and polluted water. Although many of these potential hazards already exist in one form or another in some grazing areas, mining activities would increase the concentration of the hazards. However, according to Monsanto, there have been no such accidents during its 25 years of operation.

Before the development of phosphate mining, livestock operations, summer headquarters, and other facilities were essentially isolated from those not closely associated with or empathic with the livestock industry. Since then, roads have been built into the remote rangeland to transport both miners and ore, and the area is no longer inaccessible: miners, hunters, and the general public now have ready access to range areas. Further development of road systems related to mining will further increase access and intensify the existing problems of theft, vandalism, and rustling.

Fluorosis in cattle and sheep have been documented in the vicinity of the present phosphate-processing plants. Chronic fluorosis in farm animals has been reported in areas adjacent to industrial plants emitting fluorine-containing gases and dusts. Fluorine is liberated during acidulation and electric-furnace reduction of phosphate rock; the amount currently being produced from phosphate rock is not known. Livestock ingest the fluorine by grazing forage and consuming hay on which these gases and dusts have settled.

Fluoride emissions will likely increase with increased production, unless stringent control measures are effectively enforced. Air-quality studies, based on existing conditions, indicate that fluorine emissions, primarily from the existing fertilizer plants, will be above tolerable limits within a radius of about 2 miles of the plants. As a result, further cases of fluorosis can be expected.

Each of the above impacts will likely have an adverse effect on the profitability and continued operation of farms and ranches in the area, unless significant mitigating measures are implemented. It is not known to what degree these impacts will affect the continued operation of farms and ranches in the area. however.

2. SOCIOECONOMIC DEVELOPMENT

Since the preparation of the draft statement, the Southeast Idaho Council of Governments (SICOG) has substantially modified its populations projections. The modification of the overall growth reflects more nearly recent growth experiences; the modifications of the phosphate-related growth is based upon a more probable level of mining as shown in figure 1-1a.

Based upon the original population projections and the original projected growth of the phosphate industry as based upon mining plans as originally submitted, projected increases in phosphate mining and processing in the eight counties of southeastern Idaho will substantially increase population labor force and income projections for the region. Basic phosphate mining and related employment would increase by 2,335 jobs between 1975 and the year 2000. This increase in basic employment will create positions in nonbasic supporting industries by a multiple of 1.8, thus generating an additional 4,203 nonbasic jobs for a total employment impact of 6,538 new employment opportunities and a population increase of 17,915. Since the majority of these positions will be created in the very near future, 1976-80, the resulting population change will be subject to additional normal growth rates between then and the year 2000 due to in-migration and births in region. These 6,538 jobs, therefore, will in reality grow to approximately 8,100 jobs by the year 2000, and the resulting population increase will be 22,300. Total labor force membership for the region will be approximately 124,000, and total projected population will grow to 339,400.

Two methods were employed to derive population and employment projections for the 25-year period. These were the baseline projection method and the interactive population/employment forecasting model (IPEF-73). Both of these methods utilize the export-base theory of regional growth. In the IPEF-73 model, this approach is synthesized with the cohort-survival method of population forecasting. An exogeneous change in basic employment, such as the employment increase associated with the proposed phosphate development in southeast Idaho, will result in a predictable change in nonbasic or indirect employment. This allows computation of total employment impact projections.

The baseline method of projection requires that multipliers be determined and applied to employment and population bases. The multiplier used to estimate indirect employment from direct or basic employment was 1.8. The multiplier to estimate population growth from new employment created was 2.74. This means that 10 new jobs in basic employment would generate employment for 28 persons (basic and nonbasic) and, in turn, would lead to an increase in population of 77 persons. In applying the multipliers, the impact was delayed 1 year, thus simulating the interval that often occurs between the introduction of new basic employment and the appearance of supporting indirect employment.

The IPEF-73 Model synthesizes two widely used techniques: the cohort-survival method of population forecasting, and an econometric approach using the export-base theory of employment forecasting. The cohort-survival method considers such factors as birth rates, death rates, and historical migration patterns. The econometric model derives forecasts from past employment trends, national and State growth patterns, and interindustry relationships. The two approaches are combined so that the links between population and economic sectors are explicit.

A comparison of population forecasts derived from the two methods at 5-year intervals through 2000 for the eight-county region is shown in the following table.

Comparison of economic base and IPEF projections
for the eight-county region through 2000

Category	1970*	1975*	1980**	1985**	1990**	1995**	2000**
Population							
IPEF-73	160,000	175,000	207,328	232,300	260,200	288,000	317,400
Economic Base	160,053	177,000	228,900	253,600	280,200	308,100	339,400
Difference: (#)	-0-	2,000	21,572	21,300	20,000	20,100	22,000
(%)	-0-	1.1%	10.4%	9.2%	7.7%	7.0%	6.9%

* Actual.
** Estimated.
Source: Southeast Idaho Council of Governments.

There is a good degree of consistency in the population forecasts although the methods operate quite differently. The multipliers between direct (basic) and indirect employment, and between total new employment and population growth, are derived internally within the IPEF-73 Model as a result of interaction between the employment and population subsystems.

Economic baseline projections were used for deriving coefficients (multipliers) between population growth and various social factors, such as housing needs, and education, health, and public-service demand, because IPEF-73 projections are not available for all counties in the SICOG region. The county-by-county calibration of IPEF is presently being undertaken by SICOG.

The following assumptions have been made in projecting the impacts of the proposed phosphate development in southeastern Idaho.

> The population and employment impact will be restricted to the 3 counties, Bannock, Caribou, and Bear Lake, where the proposed action would occur.
>
> The impacts on housing, education, and other public and private services will occur in the same three counties. Any dispersal of population over a broader base will spread out the demand for housing and public services. An exception in the impact is outdoor recreation opportunities and facilities. It is assumed that preferences toward outdoor recreation will be specialized and diversified and that demand will extend beyond the boundaries of the three counties.
>
> National trends, such as the availability of money for mortgage loans or a harsh recession of a sustained duration, will not be altered, thereby deterring scheduled development.
>
> Since standards for public-service programs are not generally available, a ratio between level of service and population was derived for a base year. Usually this ratio or coefficient was expressed in manpower terms. Unless evidence was available to warrant a different procedure, the coefficient was held constant throughout the forecast period in arriving at personnel needs to staff public-service and private programs and to estimate demands for facilities.

Income in this region, assuming a 5-percent annual rate of growth and a population increase to 339,400 persons, should be in the neighborhood of $4.073 billion, $260 million above the projected income without the additional phosphate activity. This figure understates the actual impact on total income in this area since most of the basic employment increase will be in highly skilled and semiskilled types of employment. Each basic job opening will generate demand for supporting employment in the nonbasic or local-serving sector, amplifying the impact of basic employment increases.

Although basic employment impacts primarily are restricted to Bannock, Bear Lake, and Caribou Counties, indirect employment and population increases may extend beyond their borders along transportation corridors to the surrounding counties. The extent of population dispersion may depend upon the availability of a public transportation system and the capacity of surrounding areas to absorb new residents.

The population impact is shown in the following table.

Population, employment impact due to phosphate mining in eight southeastern counties in the year 2000

County	Population	Employment
Bannock	4,600	1,680
Bear Lake	4,900	1,790
Bingham	-0-	-0-
Caribou	12,800	4,670
Franklin	-0-	-0-
Oneida	-0-	-0-
Power	-0-	-0-
SICOG	22,300	8,140
Bonneville	-0-	-0-
8-County	22,300	8,140

The income impact of the expansion of phosphate mining in the region is projected to be $260 million by the year 2000. This figure is understated, however, since phosphate mining and processing personnel command substantially higher salaries than the average worker.

The study area will experience significant social impacts as a result of the proposed phosphate development. These impacts will be concurrent with economic and population growth patterns. The total effect upon the eight-county region will be to increase population approximately 13 percent above what the growth would be without the proposed action.

The population impact will vary throughout the region, with most of the effects occurring in three counties. In Bannock County, the growth will be in addition to pressures already created by the establishment of a Bucyrus-Erie plant in Pocatello and attendant growth due to indirect employment. In Bear Lake County, a long-term population decline will be reversed. New jobs created by the proposed action will enable residents to remain in the county and will attract numerous outsiders to fill new positions that will become available. Population in Caribou County will soar to more than 400 percent of the 1970 population by 2000. A total of 12,800 persons will be added to the county's population because of the proposed development. These population impacts will cause an immediate increase in the demand for new housing and such public services as education, health, law enforcement, and outdoor recreational opportunities.

The housing forecast was based upon the methodology used by the Federal Housing Administration. The technique calls for the division of the projected population increase by the current housing density to arrive at a demand for housing units. The number of persons per occupied unit in 1970 in each of the counties was: Bannock, 3.2; Bear Lake, 3.2; and Caribou, 3.6. The housing estimates for 1975 were derived by dividing the number of persons per occupied unit into the population estimates for that year.

In making long-term forecasts, however, past trends need to be taken into account in projecting housing needs. One such trend is noted in the "Final Report" of the 1970 Census of Population and Housing in Idaho (1971). The growing number of single elderly heads of household supports this trend, as does a decline in fertility rates. Because of these trends, projections for the number of persons per occupied household, developed by the Bonneville Power Administration, are used to derive housing demands through the year 2000 in the three counties. These projections are reported in the following table. Projected persons per household (pph) are assumed to comply with BPA projections in Bannock and Bear Lake Counties. Projected pph ratios for Caribou County are adjusted 0.4 percent higher than BPA projections to continue the higher rate that existed in 1970.

Heads of Household
(Occupied Housing)
Actual 1940 to 1970; Projected 1975 to 1990*

Year		Population Per Household
1940	(Actual)	3.68
1950	"	3.52
1960	"	3.44
1965	(Estimated)	3.38
1970	(Actual)	3.26
1975	(Projected)	3.08
1980	"	2.92
1985	"	2.83
1990	"	2.77
1995**	"	2.77**
2000**	"	2.77**

*Source: Population, Employment and Housing Units Projected to 1990; Idaho, U.S. Department of Interior, Bonneville Power Administration, February, 1973, p. 82.

**Projections for 1995 and 2000 have been added to the BPA projections at the 1990 rate.

The total housing demand attributed to the phosphate development through 1980 is 890 units in Bannock County, 719 units in Bear Lake County, and 2,048 units in Caribou County. The housing demand will increase through the year 2000 to 1,661 units in Bannock County, 1,769 units in Bear Lake County, and 4,038 units in Caribou County. The total housing impact due to the proposed phosphate development for the three counties is projected to be 3,657 units in 1980, 6,224 in 1990 and 7,468 units in the year 2000.

It is estimated that 65 percent of the incoming population will live in mobile homes, 25 percent in single-family units and 10-percent in multifamily units during the period 1975-80. Following 1980, the housing pattern of incoming population is projected to be 65-percent single-family units, 25-percent mobile homes, and 10-percent multifamily units.

Housing demands through 1980 will require 118.4 acres for housing and 37.2 acres for streets in Bannock County, 95.5 acres for housing and 29.9 acres for streets in Bear Lake County, and 309.1 acres for housing and 97.1 acres for streets in Caribou County. By the year 2000, the land use requirements for housing will be 244.7 acres for units and 82.9 acres for streets in Bannock County, 290.8 acres for units and 88.9 acres for streets in Bear Lake County, and 641.0 acres for units and 216.4 acres for streets in Caribou County.

In Bannock County, the additional units will be part of a building boom which will result in more intensive development within the city boundaries, and annexation and extensive development within the county. The smaller cities in the Marsh Valley, especially Inkom, Lava Hot Springs, and McCammon, as well as Chubbuck, will feel the impact of this development. In Bear Lake, the incoming population may choose to rehabilitate older single-family dwellings and convert some of them to multifamily units to meet some of the housing demand. It is expected that most of the growth will occur within the boundaries of the City of Montpelier and the smaller cities to the south. The City of Soda Springs is expected to absorb most of the incoming population in Caribou County. Currently, 995 acres (46 percent of the land within the city limits) is classified as undeveloped in Soda Springs.

The population increase which accompanies the development of the phosphate region will be reflected in additional demands for public education personnel and facilities. Marsh Valley, Pocatello, and Soda Springs school districts will exceed their present elementary and secondary school capacities, with or without the development of the phosphate resources, by 1980. The Bear Lake School District will not exceed its elementary and secondary capacity by the year 2000 in the absence of the development of the phosphate resources; with such development, however, the Bear Lake School District will exceed both elementary and secondary capacities by 1980. The Grace School District population should not outstrip either the elementary or secondary facilities capacity by 2000, with or without the development of the phosphate resources. In the absence of the development of the phosphate resources, the North Gem School District will not have to expand its present student capacity; however, with the development of the phosphate region, the district will outstrip its present elementary and secondary capacities by 1985. Projections on increased enrollment and costs are shown in tables 1-43 and 1-44. The debt-incurring capacities of the school districts are shown in table 1-45.

The expansion of additional plant facilities outside Bannock County will create permanent fiscal hardships on the people of School

Table 1-43.--Increased elementary and secondary public school enrollments above normal growth caused by development of phosphate region, 1975-2000

	1975		1980		1985	
County/District	Elem.	Sec.	Elem.	Sec.	Elem.	Sec.
BANNOCK						
Marsh Valley (21)	0	0	44	23	61	32
Pocatello (25)	0	0	398	206	550	285
TOTAL	0	0	442	229	611	317
BEAR LAKE (33)	0	0	362	185	496	255
CARIBOU						
Grace (148)	0	0	115	59	149	77
North Gem (149)	0	0	115	59	149	77
Soda Springs (150)	0	0	925	479	1,197	619
TOTAL	0	0	1,155	597	1,495	773
TOTAL	0	0	1,955	1,012	2,601	1,346

	1990		1995		2000	
County/District	Elem.	Sec.	Elem.	Sec.	Elem.	Sec.
BANNOCK						
Marsh Valley (21)	68	35	73	38	78	41
Pocatello (25)	613	317	659	340	704	364
TOTAL	681	352	732	378	782	405
BEAR LAKE (33)	770	396	804	414	838	431
CARIBOU						
Grace (148)	170	88	192	100	218	113
North Gem (149)	170	88	192	100	218	113
Soda Springs (150)	1,360	704	1,537	795	1,741	901
TOTAL	1,700	880	1,921	995	2,177	1,127
TOTAL	3,145	1,628	3,451	1,786	3,791	1,962

Source: Southeast Idaho Council of Governments.

Table 1-44.--Estimated costs to school districts, in thousand dollars, to expand elementary (grades 1-8) and secondary (grades 9-12) public school facilities to accommodate projected increased enrollment, with and without development of southeastern Idaho phosphate resources, 1980 to 2000[1,2]

County and district	Without phosphate development		With phosphate development	
	Elementary	Secondary	Elementary	Secondary
		1980		
Bannock				
Marsh Valley (21)	$1,703	$951	$1,874	$1,040
Pocatello (25)	20,335	11,204	21,886	11,695
Bear Lake (33)	0	0	647	160
Caribou				
Grace (148)	0	0	0	0
North Gem (149)	0	0	0	51
Soda Springs (150)	846	394	4,450	2,260
		1985		
Bannock				
Marsh Valley (21)	$2,860	$1,567	$3,163	$1,726
Pocatello (25)	32,122	17,494	34,858	18,911
Bear Lake (33)	0	0	1,323	468
Caribou				
Grace (148)	0	0	0	0
North Gem (149)	0	0	104	204
Soda Springs (150)	1,825	890	7,779	3,969
		1990		
Bannock				
Marsh Valley (21)	$4,596	$2,495	$5,028	$2,717
Pocatello (25)	49,533	26,750	53,425	28,763
Bear Lake (33)	0	0	3,212	1,378
Caribou				
Grace (148)	0	0	0	0
North Gem (149)	0	0	406	400
Soda Springs (150)	3,453	1,714	12,087	6,183

[1] Data from Southeast Idaho Council of Governments.

[2] Costs are based on a national average of cost per pupil computed from the average of school district size, elementary or secondary level and new construction or additions (School Management, May, 1974, p. 21). Costs are projected at 5 percent increase per year.

Table 1-44.--Estimated costs to school districts to expand elementary and secondary public school facilities to accommodate projected increased enrollment--Continued

County and district	Without phosphate development		With phosphate development	
	Elementary	Secondary	Elementary	Secondary
	1995			
Bannock				
Marsh Valley (21)	$7,202	$3,872	$7,793	$4,180
Pocatello (25)	75,234	40,359	80,573	43,114
Bear Lake (33)	0	0	4,099	1,859
Caribou				
Grace (148)	0	0	0	0
North Gem (149)	0	97	899	713
Soda Springs (150)	6,060	3,046	18,511	9,486
	2000			
Bannock				
Marsh Valley (21)	$11,042	$5,893	$11,848	$6,317
Pocatello (25)	112,633	60,111	119,912	63,874
Bear Lake (33)	0	0	5,232	2,244
Caribou				
Grace (148)	0	0	62	0
North Gem (149)	0	31	1,716	1,199
Soda Springs (150)	10,122	5,128	18,122	14,444

Table 1-45.--Unexhausted debt-incurring capacities, in thousand dollars, of school districts in Bannock, Bear Lake, and Caribou Counties, 1975[1,2]

County and district	25 percent assessed valuation in district[3]	Outstanding indebtedness[3]	Unexhausted debt-incurring capacity
Bannock			
Marsh Valley (21)	$2,783	$1,400	$1,383
Pocatello (25)	13,773	9,671	4,102
Total	$16,556	$11,071	$5,485
Bear Lake (33)	$3,529	$121	$3,408
Caribou			
Grace (148)	$1,756	0	$1,756
North Gem (149)	1,316	0	1,316
Soda Springs (150)	4,000	350	3,650
Total	$7,072	$350	$6,722

[1] Data from Southeast Idaho Council of Governments.

[2] The unexhausted debt-incurring capacity of a school district is defined in the Idaho Code 33-1103. It is computed by subtracting the outstanding indebtedness of the district from 25 percent of the assessed valuation within the district.

[3] The assessed valuation and outstanding indebtedness figures were obtained from the respective school district offices.

District 25. While additional processing facilities in Bear Lake and Caribou Counties will broaden the property tax base in those areas, general property tax increases may be necessary to cover the increased requirements of new and expanded facilities and public-service programs.

While the impact on current operating expenses is considerable, current year funding from the State mitigates it somewhat and in a relatively responsive fashion. However, the impact on facilities and equipment may be much more severe. It takes time to increase the county tax rolls which in turn increases a school district's bonding capacity of 25 percent of the assessed valuation. Months are required to propose, hold and pass a school bond election. If it is successful, given the difficulties of obtaining a two-thirds majority, the time needed to complete construction is at best 12 months. In total it may take two years or longer to enable a school district to catch up to its students in terms of providing facilities and equipment. It is expected that the fiscal lag will affect other areas, including law-enforcement, utilities (sewer and water), and health services.

Expansion of phosphate mining does not necessarily mean increased health and safety problems. With continued emphasis on health and safety programs by MESA, it is possible that health and safety problems directly related to mining could be reduced. At present, all mines in production are open-pit mines. If, in the future, there should be extensive underground operations in the area, other health and safety problems peculiar to underground mining would be encountered.

The impact on the health services of the region will be a direct result of the increase in population, which will affect the various factors in the region's health profile differently. For example, the Idaho Bureau of Vital Statistics reports that the death rate in Idaho does not vary greatly from year to year; hence, increased population attendant with the phosphate extraction will have little effect on the death rate caused by the leading causes of death in Idaho--heart disease, malignant neoplasms, cerebrovascular disease and accidents. However, studies indicate that the frequency of severe communicable disease increases with increasing population density.

The demand for health-care personnel induced by the proposed development of the phosphate is as follows: By the year 2000, the increased population, above normal growth, caused by the development of the phosphate will require an additional 13 physicians, 3 dentists, and 33 registered nurses in Bannock County; an additional 13 physicians, 3 dentists, and 34 registered nurses in Bear Lake County; and an additional 35 physicians, 8 dentists and 89 registered nurses in Caribou County.

On the basis of needs for hospital beds on the standard of 4.5 beds per 1,000 population, less the number of beds represented by the current occupancy rate, the three counties by the year 2000 will have to increase their bed capacity above the current capacity as follows: Bannock County, 94 beds, and Caribou County, 11 beds; and Bear Lake County will not have to increase its bed capacity.

The development of the proposed action will have a decided impact upon law-enforcement needs in the three counties of major impact.

The number of new personnel attributed directly to the phosphate development is shown in the following table:

County	Law Enforcement Personnel Required to Maintain 1975 Ratio				
	1980	1985	1990	1995	2000
Bannock	4	6	7	7	8
Bear Lake	4	6	9	9	9
Caribou	13	16	19	21	24
TOTAL	21	28	35	37	41

If the 1973 rate is used as a standard, 21 new law-enforcement personnel would be added in the three counties by 1980, 28 by 1985, 35 by 1990, 37 by 1995, and a total of 41 by the year 2000. The greatest immediate impact due to phosphate development will be felt in Caribou County where 13 additional officers will be required by 1980 to maintain the 1973 rate.

Approximately 1,680 acres of land will be required for the housing units and commercial and supportive public services that will be available to the incoming population. Residential impact on land use is summarized in the following table:

County	Year	Net Residential Acres	Street Acres	Total Acres
Bannock	1980	118.4	37.2	155.6
	1990	212.9	72.2	285.1
	2000	244.7	82.9	327.6
Bear Lake	1980	95.5	29.9	125.4
	1990	248.7	84.3	333.0
	2000	290.8	88.9	379.7
Caribou	1980	309.1	97.1	406.2
	1990	497.0	168.9	666.5
	2000	641.0	216.4	857.4
TOTAL	1980	523.0	164.2	687.2
	1990	959.2	325.4	1,284.6
	2000	1,176.5	388.2	1,564.7

Source: Southeast Idaho Council of Governments.

The ratio between residential and nonresidential support is based upon current land use allocations in the City of Pocatello. Nonresidential support includes commercial and industrial uses as well as parks, public buildings, streets, and semipublic facilities such as churches and synagogues. The combined primary and secondary disturbance due to the proposed phosphate development will be 13,168 acres by the year 2000. This impact will occur on a land use base that will be experiencing radical changes throughout the eight-county area without the proposed action.

Revenue impacts from the proposed phosphate activity will be felt at all levels of government, resulting from a variety of taxes and charges. The local impact will be felt primarily as a result of an increase in the property tax. These revenue increases are an offset to the increased costs that will occur for the provision of increased police protection, education, and other local services.

It is not known to what degree existing land owners will bear this additional tax burden. If existing landowners bear most of this burden, agricultural lands, may be subdivided at a rate that may not be justified socially. Furthermore, to the degree that new residents have higher incomes than existing residents and if existing residents bear the cost of these taxes there will be a significant redistribution of wealth from the relative poor to the relative rich.

In addition to increased property tax receipts from expanded housing, there will be more taxes received from the mines, plants, and supporting local service businesses that spring up. The amounts of these taxes are difficult to project since assessed valuations of such facilities are difficult to project.

The property tax, however, accounts for only a portion of the revenues of local governments in Idaho. The State returns to local governments in Idaho 20 percent of all the sales taxes collected. The State also gives substantial support to school districts, accounting, for example, for over half of the revenue receipts from all sources for the Pocatello school district in 1974. Additional revenues also return to school districts from the alcohol beverages tax. Local governments receive money from the State gasoline tax to assist in road development and maintenance. All of these receipts are partial offsetting measures to the costs that will be incurred by local governments resulting from the phosphate activity and the resulting increased population. State sales and income tax receipts should increase as income goes up in the region. This will increase State general-fund receipts from which appropriations are made to support local governments. There is no guarantee that this area will receive these receipts in proportion to the amount generated nor in sufficient amounts to supply the needs projected above.

Receipts from the 2-percent mine license fee will depend on the net income of the mining companies. Inasmuch as this is not related to ore production and could vary, no firm estimates of the revenues from this source can be made.

A major source of revenue is from rentals, bonus bids and royalties on Federal mineral leases. Currently, the royalty rates on phosphate production is 5-percent of the value of the ore mined, with a minimum royalty of 25 cents per ton. Assuming an average annual production of 10 million tons to the year 2000, the minimum royalty will average 2.5 million. Of this, 50% goes to the State of Idaho. In turn the State distributes 90% of this amount to the public school income fund and 10% to the counties impacted by mineral leases for construction and maintenance of public roads or for the support of public schools.

The 50 percent returned to the state, however, is not returned to the local areas in the same proportion as the amounts were generated. Thus, other areas in Idaho may receive increased Federal in lieu (of taxes) payments which were generated as a result of mining in the area being considered while this are receives a relatively small portion of these revenues. Thus, significant redistributions of income may occur both within the area as well as when this area is compared to other communities in Idaho. Furthermore, if new residents of the area purchase a large percent of their goods and services (e.g. cars, furniture) outside of the area (e.g. Logan or Salt Lake City, Utah) This area may bear a large portion of the costs of local social services while receiving minimal revenues.

High growth situations compound the need for public-services. New residents, families, and single persons bring with them a great many social and health-service needs, such as housing, classroom spaces, day care centers, hospital beds and doctors, recreation, education, police protection, and nursing homes and social centers for the aged. An awareness of the nature and scope of local government problems caused by rapid growth is spreading because of a few well publicized instances. Two Wyoming communities--Rock Springs and Gillette--have received national attention as a result of the deterioration of living standards which accompanied high growth rates. The population of Rock Springs grew 18 percent per year from 1970 to 1973.

Baseline projections for the three counties of primary impact in southeast Idaho estimate a steady increase in population in Bannock and Caribou Counties and a long-term population decline in Bear Lake County. Bannock is expected to increase in population at the rate of 9.2 percent per year during the next 5 years, owing to employment expansion at the Bucyrus-Erie plant. The projected population impact as a result of the proposed mining and processing would be 2,600. This would result in an annual growth rate of 10.1 percent in Bannock County through 1985. The impact on population trends in Bear Lake County would reverse the projected decline, resulting in a net increase of 2,100 persons in 1985. This would be a 7.5 percent annual rate of growth.

The greatest population impact due to the phosphate development would occur in Caribou County. The projected increase of 6,800 persons by 1980 would represent an annual growth of 18.4 percent, the equivalent of the annual growth rate experienced in Rock Springs between 1970 and 1973. Furthermore, population increase caused by the proposed action would grow to 8,800 in 1985 and to 10,000 in 1990. Following the initial surge of newcomers first to construct and then to operate facilities, a long-term period of rapid growth would continue in Caribou County, equalling 11.9 percent a year through 1985 and 9.0 annually through 1990, using 1975 as a base year.

If the social characteristics of new residents differ significantly from local residents, social conflicts could arise and affect the stability of these communities. The possible impact of those effects are not known at this time.

The dispersal of incoming population over a broader area beyond the three counties of primary impact may occur as a consequence of private decisions and actions. The assumption that all of the incoming population would settle in Bannock, Bear Lake, and Caribou Counties was based upon the tremendous growth pressures that exist in each of the contiguous counties and the relatively long distances between the central communities in each of the contiguous counties and other population centers outside these counties in the region. Bannock County growth may expand into American Falls (Power County) and Blackfoot (Bingham County) and may develop more intensely the growth potential that exists in the county's southern communities. In Bear Lake County, most of the growth will likely occur between Montpelier and Paris. Lincoln County, Wyo., could be slightly affected in the Sage and Cokeville area.

Based upon the revised projections, which include mining at a more probable level of 15 million tons by the year 2000, as shown in table 1-1a, impacts will be considerably less.

The parameters of population growth based upon current developments and the proposed phosphate expansion for the seven southeastern Idaho counties are indicated in the following table.

HIGH, MEDIUM AND LOW POPULATION PROJECTIONS
FOR THE YEAR 2000
FOR THE SEVEN SOUTHEASTERN IDAHO COUNTIES

	HIGH	MEDIUM	LOW
BANNOCK	130,000	119,368	102,000
BEAR LAKE	9,500	6,424	4,962
BINGHAM	57,000	47,787	40,300
CARIBOU	17,600	12,344	9,006
FRANKLIN	12,200	7,239	6,500
POWER	9,190	8,839	7,500
ONEIDA	3,600	2,426	2,100
TOTAL	239,090	204,427	172,368

Source: SICOG and GRI

The high projections reflect the highest level of population increase that would be expected to occur given full utilization of the present labor force and the highest projected expansion of the phosphate industry. The low projections represent no further growth in the phosphate industry and a diminution of the current impetus for development evident in the seven counties.

The medium or middle range projections reflect a continuing impetus at current levels of known industrial and related expansion, and phosphate employment revised downward to twenty-eight percent of the impacts projected in the draft statement. The socioeconomic impacts analyzed here are based on the middle-range projections which forecast a total population of 205,427 by the year 2000. In contrast, the sum of the high forecasts for the seven counties is 239,090, while the sum of the low forecasts is 172,368. These three levels of projections compare with the two different projections made for the southeast region as a whole in the draft statement. The economic baseline projections, which were used for county by county projections, totaled 225,000 for the year 2000, while the IPEF regional projections were 231,200.

The projected population changes for each county by five year intervals based upon the medium rate of growth are summarized in the following table.

COUNTY	1970	1975	1980	1985	1990	1995	2000
Bannock	52,200	55,999	75,253	85,559	96,670	107,613	119,368
Bingham	29,167	32,807	35,061	38,991	43,385	46,225	47,787
Bear Lake	5,801	5,406	5,950	6,289	6,952	6,797	6,424
Caribou	6,534	7,959	9,501	10,967	11,692	12,218	12,344
Franklin	7,374	7,587	7,166	7,129	7,486	7,502	7,239
Oneida	2,864	2,709	2,638	2,672	2,709	2,594	2,426
Power	4,864	5,748	6,288	6,807	7,718	8,343	8,839
Total/ Region	108,803	118,215	141,857	158,414	176,613	191,292	204,427

Source: SICOG/GRI

Every county in the region except Franklin and Oneida is projected to experience growth over the next twenty-five years. The projected decline in Franklin County could be reversed as the result of continued expansion in Cache County in northern Utah. A decline would also be forecast in Bear Lake were it not for the proposed expansion of the phosphate industry in that county.

Table 1-45a indicates what portion of the population growth is projected to occur as a result of the proposed phosphate expansion. As in the draft statement, the phosphate impact is projected to occur in three counties: Bannock, Bear Lake and Caribou. The impact on the population by growth is projected to be approximately 6,493 at the more probable level of mining. This relatively low employment-population ratio is the result of 1) smaller family sizes as projected by Bonneville Power Authority since new workers in the region seem to be younger

Table 1-45a.--Population projections based upon a more probable level of mining, as shown in Table 1-1a

COUNTY	1970	1975	1980	1985	1990	1995	2000
BANNOCK							
With Phosphate	52,200	55,999	75,253	85,559	96,670	107,613	119,368
W/O Phosphate	52,200	54,697	73,956	84,006	95,056	105,962	117,675
Phosphate Impact	-0-	-0-	1,297	1,553	1,614	1,651	1,693
BEAR LAKE							
With Phosphate	5,801	5,406	5,950	6,289	6,952	6,797	6,424
W/O Phosphate	5,801	5,406	5,139	5,256	5,464	5,304	4,962
Phosphate Impact	-0-	-0-	811	1,033	1,488	1,493	1,462
BINGHAM	29,167	32,807	35,061	38,991	43,386	46,225	47,787
CARIBOU							
With Phosphate	6,534	7,959	9,501	10,967	11,692	12,218	12,344
W/O Phosphate	6,534	7,959	7,835	7,946	8,582	8,948	9,006
Phosphate Impact	-0-	-0-	1,666	3,021	3,110	3,270	3,338
FRANKLIN	7,374	7,587	7,166	7,129	7,486	7,502	7,239
ONEIDA	2,864	2,709	2,638	2,672	2,709	2,594	2,426
POWER	4,825	5,748	6,288	6,807	7,718	8,343	8,339

Source: SICOG/GRI

and/or unmarried, 2) the emergence of more than one wage earner in a family which reflects the tendency of wives and older children to enter the labor market, 3) and the presence of commuters within the labor force. It is assumed that the work force in a study area is wholly contained within the area. Commuters tend to distort actual population impacts because they are counted as heads of families situated within the study area; instead they make no population impact within the area, but maintain housing units, have families which attend schools and make demands on other kinds of government services outside the area. Insofar as a county attracts workers who commute from another county, the impacts may be overstated. The population projections for the seven counties vary approximately one percent with these of Boise State University and the U. S. Census.

Employment

Employment by five-year interval is shown in table 1-45b. These projections are made on the basis of industries which currently are operating in the seven-county area plus that of the phosphate industry at the more probable level of mining. Construction employment on the American Falls dam is expected to phase out before 1980 and therefore is not included in the population projections. Total employment is forecast to increase from an estimated 40,129 employees in 1970 to 87,641 in 2000; of these, 2,806 will be directly or indirectly related to phosphate industry.

Housing

The housing demand created by the increase in population will more than double between 1970 and 2000, with phosphate expansion expected to generate a demand for 2,218 additional housing units. Every county but Oneida is projected to have an increased demand over the twenty-five year period. The need for more houses even in counties with a stable or declining population will occur because of the diminishing family size in southeast Idaho. Furthermore, it is anticipated that 41% of the new households due to the phosphate development in southeast Idaho will be employed in nonbasic industries. The annual wage rate for indirect employment will not provide an adequate income to purchase permanent housing without two incomes per household. Therefore over 2,218 households (nonbasic) will require some form of financial assistance in order to purchase permanent housing.

If these families opt for mobile homes besides the estimated 800 construction worker households that probably will prefer mobile homes the impact on the communities will have several adverse effects. The financial impact on the local governments and school districts will be critical because the tax revenues on mobile homes is much lower than on permanent housing. The aesthetic quality of life in the communities will also be adversely affected because of the large number of mobile home courts through the cities and counties.

Budgetary projections and fiscal impacts are shown in table 1-45c. More detailed combined county-unit data for 23 cities, 17 school

Table 1-45b.--Employment projections; phosphate impact based upon more probable level of mining as shown in table 1-1a.

COUNTY	1970	1975	1980	1985	1990	1995	2000
BANNOCK							
With Phosphate	18,546	23,562	32,518	37,161	42,146	47,612	53,596
W/O Phosphate	18,546	22,963	31,919	36,442	41,416	46,881	52,859
Phosphate Impact	-0-	-0-	599	719	730	731	737
BEAR LAKE							
With Phosphate	1,962	1,962	2,190	2,280	2,487	2,471	2,430
W/O Phosphate	1,962	1,962	1,853	1,850	1,869	1,863	1,847
Phosphate Impact	-0-	-0-	337	430	618	608	583
BINGHAM	11,623	12,878	18,781	14,983	16,420	17,726	18,952
CARIBOU							
With Phosphate	2,708	3,329	4,150	4,813	5,005	5,210	5,340
W/O Phosphate	2,708	3,329	3,376	3,404	3,568	3,724	3,854
Phosphate Impact	-0-	-0-	774	1,409	1,437	1,486	1,486
FRANKLIN	2,361	2,606	2,527	2,527	2,590	2,643	2,681
ONEIDA	1,127	1,115	1,079	1,072	1,070	1,059	1,047
POWER	1,802	2,291	2,557	2,732	3,045	3,319	3,595

Source: SICOG/GRI

TABLE 45c
COMBINED CITY/COUNTY/SCHOOL DISTRICT

FISCAL IMPACTS
(Figures are in non-inflacted 1975 dollars)

COUNTY	1975 Break Even Tax Rate *	1975 (Base Year) County-wide Expenditures	1980 Surplus or Deficit	Tax Rate Change *	1980 County-wide Expenditures	1985 Surplus or Deficit	Tax Rate Change *	1985 County-wide Expenditures	1990 Surplus or Deficit	Tax Rate Change *	1990 County-wide Expenditures
Bannock	51.179										
with phosphate		11,247,000	+474,300	-1.593	14,757,000	+536,800	-1.581	16,825,700	+483,900	-1.257	19,206,100
w/o phosphate		11,247,000	+474,800	-1.623	14,500,100	+529,100	-1.588	16,522,700	+469,800	-1.242	18,894,800
phosphate impact				-0.030			-0.007			+0.015	
Bear Lake	27.139										
with phosphate		967,420	+58,700	-1.355	946,700	+13,900	-0.099	997,100	-144,200	+4.290	1,187,300
w/o phosphate		967,300	+138,900	-5.030	800,800	+108,800	-3.553	820,300	-14,600	+1.667	933,600
phosphate impact				-3.675			-3.454			+3.770	
Bingham	37.075	4,888,800	+274,596	-1.957	4,913,800	+72,900	-0.480	5,501,300	-385,900	+2.386	6,395,800
Caribou	22.66										
with phosphate		479,000	+117,900	-1.312	495,700	+188,500	-1.781	537,800	+184,200	-1.634	588,700
w/o phosphate		479,000	+84,700	-1.186	406,400	+146,000	-1.912	379,000	+137,700	-1.668	429,600
phosphate impact				-0.126			-0.131			-0.034	
Franklin	47.35	1,373,600	+112,200	-4.058	1,195,700	+114,500	-4.281	1,150,700	-45,200	+1.763	1,259,700
Oneida	42.47	957,200	+92,800	-4.307	823,100	+35,900	-1.732	846,200	-90,400	+4.489	944,300
Power	17.10	1,065,600	+140,800	-2.033	1,044,200	+160,000	-2.165	1,103,900	+69,400	-0.850	1,325,000

*Tax rate changes anticipated to balance combined budgets relative to 1975. Tax increases are represented by positive values and tax decreases by negative values. Tax rate changes should be considered with respect to calculated 1975 County-wide Break Even Tax Rates. For example: a -1.593 change between 1975 and 1980 for Bannock County is a change of -3.1%; and a + 3.770 change between 1975 and 1990 for Bear Lake County is a change of 13.9%.

The above figures are projected from 1975 operating and revenue figures and exclude major capital expenditures or changes in the level or composition of government services.

Source: SICOG/GRI

districts, and 7 counties have been developed by SICOG and are available. The composites, by counties, are shown in table 1-45c.

Table 1-45c contains the combined city/school district/county fiscal projections for each of the seven counties examined in this study. These combined figures include all revenues and operating expenditures for local governments (selected cities, all school districts and the county) in each county. The table indicates the combined operating expenditures, the surplus or deficit in dollars which can be anticipated to meet such expenses if mill levies assessed in 1975 are continued throughout the forecast period, and the mill levy adjustment required to yield the revenue needed to meet anticipated operating expenditures.

The interpretation of table 1-45c combined results may be illustrated by examining the projections for Bear Lake County. The ad valorem tax rate for all units in Bear Lake County in 1975 was 27.139 which generated, together with the sources of revenue (state collected and shared revenues and Federal revenue sharing), a total of $967,420. If the same tax rate were used in 1980, the tax yield would be $946,700; $997,100 in 1985; and $1,187,300 in 1990. Using 1975 as a base and a constant ratio, the ad valorem tax rate could be reduced by 1.355 mills to generate the necessary revenue for operating expenses in 1980 and by .099 mills in 1985. However, the mill levy would have to be increased by 4.290 mills in Bear Lake County to cover projected operating expenditures in 1990.

The impact of proposed increase in the phosphate industry (as reflected in the IPEF population projections) would be to cause mill levy assessments to be higher in each of the five year reporting intervals in Bear Lake County. The impact of phosphate development would be 3.675 mills higher than without such development in 1980 which would raise an additional $80,000 required to meet increased operating expenses due to the phosphate impact. Corresponding increases in subsequent five year periods would be: 3.454 mills in 1985 and 3.770 mills in 1990. This means that the phosphate impact would increase operating costs of governments in each of these periods. These additional expenditures would be necessary to provide increased faculty, buses and materials in schools and other governmental services. Additional expenditures not accounted for in the analysis would be required, of course, to fund capital improvements which would further cause the mill levy assessment to rise in each of the reporting periods.

In general, table 1-45c indicates that present ad valorem tax levels would be sufficient to cover projected operating expenditures for all counties as a whole (but not specific subunits of government within each county) through 1985, but not for all counties in 1990. Only Power and Caribou counties would have sufficient revenue from 1975 level tax rates to meet operating expenditures in 1990. This is true only to the extent that no new capital expenditures were to be placed upon the property tax via bonding in Power and Caribou counties. The remaining counties including two of the three counties projected to be impacted by phosphate development would find it necessary to raise revenues to meet operating expenditures in 1990.

The combined fiscal impact of the proposed phosphate development at the lesser, more probable level of mining will be equal to an increase of .015 mills in Bannock County, 3.770 mills in Bear Lake County and a decrease of .034 mills in Caribou county in 1990 for local government operating expenditures. Again, these fiscal projections do not include the costs of capital construction which undoubtedly will further increase the fiscal impact on local governments of phosphate development. These fiscal impacts will affect local governmental jurisdictions differentially resulting in a net economic asset in some units and a deficit in others.

3. TRANSPORTATION AND UTILITIES SYSTEMS

Based upon mining plans as originally submitted, the primary impact on the State and Federal highways in the region will be the increased volume of traffic which must be accommodated by the facilities. The effects of this increased use will be reflected in greater vehicle running costs, increased number of accidents, travel delays, and impairment of user comfort and convenience. Increased traffic on the highways will cause accelerated pavement deterioration which will necessitate an intensified construction and maintenance program. The need to increase Idaho Division of Highways' staffing requirements, as a result, will possibly be a secondary impact. The impacts of expanded employment in the region are discussed more fully in the section on socioeconomics. In addition, increased traffic will impose greater access conflicts on users of roads that link adjoining lands to the transportation system.

The Idaho Division of Highways does not prepare traffic projections for the State highway system except in conjunction with pending highway improvement projects. However, 20-year traffic projections generally range from 1.5 to 2.5 times those of current traffic volumes for similar highways elsewhere in the State. These projections, however, do not apply to a region such as this where typical growth patterns will be disrupted by the expansion of phosphate mining and processing.

Quantification of the increase in traffic volume in excess of that due to normal patterns of growth cannot be accurately determined because current traffic volumes directly attributed to phosphate operations are not known.

Traffic generated by the phosphate-processing plants located north of Soda Springs can be roughly determined for the 4.3-mile segment of S. H. 34 between Soda Springs and Conda Junction by analyzing traffic count data. An average annual daily traffic flow (ADT) of 1,690 vehicles traveled this segment daily in 1973. Of this total, 475 vehicles (ADT) were counted on the adjoining Conda Road to Henry segment. The processing plants located along this section of S.H. 34 and at Conda must account for the majority of the remaining 1,275 ADT since few additional destination points are located along the highway between Soda Springs and Conda Junction. Pending plant expansions will likely result in a 30-percent increase in traffic volume on this section by 1980.

Without origin-destination traffic sampling, estimates of future traffic volumes that would result from expanded phosphate operations cannot be determined for the remaining highways in the region. Projections based on origin-destination sampling, however, might be grossly in error because current traffic composition could vary significantly in the future.

According to the Idaho Transportation Department, Federal-aid and State highway-funding levels are not adequate to meet the present rate of deterioration of the State highway system, much less the accelerated deterioration caused by expanded phosphate developments. Because of limited funding, any improvements or reconstruction related to increased traffic or heavy loads would place an untenable burden on the already underfinanced State road system.

The primary impact on the regional railroad system will also be the increased volume of rail traffic. There is presently insufficient information available to quantify the amount of increase that will possibly result. A secondary impact will be likely need for additional railroad personnel as a result of increase rail traffic.

On the Basis of projections supplied by the mining companies, the total electrical load will increase to about 270 megawatts by the mid-1980's. The major portion of the increase will result from the indicated expansion of the Monsanto Company's elemental-phosphorus plant.

The projected 270-megawatt load-increase will primarily have to be supplied by the Utah Power and Light system. On the basis of the company's load-increase forecast for present customer requirements, the current scheduling of new generating units would have to be accelerated to be able to supply the indicated load increases imposed by expanded phosphate processing in southeastern Idaho. Utah Power and Light Company indicates that power will be available for additional phosphate mining and processing, barring any unforeseen problems. Short-term deficiencies are likely, however, owing to the need for approximately 6-years leadtime to supply power to a new, major applicant and the need to develop additional generating capacity. On the other hand, Idaho Power Company projects no major phosphate-related load increases during the next 15-years. Proposed enlargement of the company's peak generating capability consequently is not related to expanded phosphate mining and processing in southeastern Idaho.

Annual exported tonnage from southeastern Idaho would increase to about 3.8 million tons (1.2 million tons raw ore, 1.6 million tons beneficiated ore) if the proposed mining should occur. In addition to Stauffer Chemical Company shipments to Silver Bow, Mont., and Leefe, Wyo., Alumet would ship beneficiated ore to southern Utah, and Earth Sciences would ship beneficiated ore to Canada. The equivalent electrical load needed to process this ore would be approximately 120 megawatts.

Since the regional power-distribution network integrates into the electrical system of the western United States and southwestern Canada, increased demand for power in the region affects the whole system to some degree. Future power demand will total roughly 5.9 billion kilowatt hours per year for phosphate mining and processing, a 180 percent increase over present consumption. This, coupled with the power demand created by a projected population increase of 22,300 people, will cause an impact on the system, primarily in the increased demand for power in excess of that presently unallocated for other uses.

However, since the preparation of the draft statement, phosphate market conditions have changed drastically and as a result the industry projected future expansion has been revised significantly. The most significant change has been Monsanto's cancellation of 270 megawatts expansion to their Soda Springs elemental phosphorous plant and mine. FMC has no current plans for elemental phosphorous plant expansion; IMC has delayed indefinitely it's plans, and Earth Sciences Inc. has announced a minimum three-year delay. At this more probable level of mining, as shown in table 1-1a, the anticipated electrical load is reduced by 237 megawatts.

Total phosphate industry electrical impact consists of 3 components: the industrial, the commercial and light support industry, and the residential loads.

Industrial load growth is anticipated at approximately 30 megawatts of which 25 megawatts can be anticipated prior to 1980 and the remaining 5 megawatts prior to 1985. Projected load growth would be in the service area of Utah Power and Light except for 8 megawatts contracted by Lower Valley Power and Light to Alumet.

New residential units requiring a projected .00459 MW/residence will create a need for 5.02 megawatts of power, based upon a 75 percent load factor.

Commercial and light industry anticipated loads are projected by comparing ratios of residential to commercial customers by number and KWH/customer usage within the impacted area.

It is anticipated that using the multiplier of 1.91 an accurate projected commercial and light industrial load can be predicted. With 1093 anticipated new residences with the impacted area the commercial and light industry growth is projected at 182 new businesses.

Projected requirements for new residents is .00459 MW/residence with the multiplier of 1.91 and 182 new businesses, the projected load growth for commercial and light industry is 1.60 megawatts through 1985.

Total electrical impact for southeastern Idaho is anticipated at approximately 37 megawatts as follows:

30 megawatts for phosphate industry,
5.02 " " residential growth,
and 1.60 " " commercial & light support industry.

The electrical impact of 37 megawatts will effect Utah Power & Light, Lower Valley Power & Light, and Soda Springs Municipal Electric Light & Power. Lower Valley will be providing approximately 8 megawatts to Alumet, Utah Power & Light would be providing the remainder. Utah Power & Light's load would be proportioned to it's customers and Soda Springs Municipal Electric Light & Power. Because of the proximity of the additional phosphate mining and plants, it is anticipated that Soda Springs Municipal Electric Light & Power will provide the majority of the residential and commercial and light industrial load. (See Map 13). Approximately 65-percent of the residential and commercial projected growth (new facilities) will be operating within a 21 mile radius of Soda Springs which leads to a 4.3 megawatt growth to be provided by Soda Springs Municipal Electric Light & Power.

Future generating plants dedicated to serve the growing phosphate industry are unlikely because of the proportional load required by the phosphate industry is small in comparison to the size of modern generating stations and total projected system load growth. This is not to say that additional generating stations are not planned for southeastern Idaho; but the phosphate industry would not be the prime factor for siting such plants.

Consideration for siting generating stations is contingent on fuel supply, water availability, load centers, and land use and transmission line corridors and will require a separate environmental impact statement and Public Utility Commission approval prior to construction. Such procedures or further considerations are not a part of this statement and will be dealt with individually when application is made for construction of new generating facilities.

4. RECREATION RESOURCES

Based upon mining plans as originally submitted, outdoor recreation in the area will be adversely affected. The mining and processing activities will affect numerous resources that contribute to the quality of outdoor recreation experiences now available.

Roads, power lines, and other supporting facilities will impact recreation opportunities. The visual impact will be dramatic. Some utilities, corridors, roads, etc. not open for public use will also cut off access to areas presently offering a diversity of opportunities for public use.

The proposed actions will reduce the quality and resources of outdoor recreation because of the dust, odor, smoke, noise, air, water, and visual pollution caused by the disruption of natural ground cover and by the introduction of people, machinery, equipment, utility and transportation systems, and manmade facilities. Even though the mining operations will be seasonal because of weather conditions, long-term (i.e., up to 50-year) to permanent effects on outdoor recreation resources and opportunities will be extensive.

The proposed mining activities will affect fish and wildlife, both directly and indirectly. The U.S. Forest Service's Recreation Information Management (RIM) program rated hunting and fishing recreation activities third and fifth in importance, respectively, in the study area. Hunting accounted for 44,100 visitor days; fishing, 30,100 visitor days. Additional projections through year 2000 for hunting, fishing and other outdoor recreation opportunities are reported in the Recreation Data Program. (Pacific Northwest River Basins Commission).

With the disturbances of ground cover and wildlife habitats by mines, roads, utility systems, and other land disturbances, there will be a significant reduction in hunting and fishing over a 25-year or more time period. During the early part of this period (the first 10 years), recreation days spent hunting and fishing will increase, owing to population growth--also a direct result of the proposed action--and the end results will be lower quality outdoor recreation experiences, reduced recreation resources, and a corresponding long-term to permanent loss in recreation days spent in these activities.

Highly diverse and high-quality recreation resources that will be environmentally impacted on a long-term to permanent basis include roadless lands that have primitive and natural phenomena characteristics, semiprimitive areas where offroad vehicles and extractive recreation opportunities are of primary importance, and numerous areas that provide passive, active, and general outdoor-recreation activities.

Since participation in hunting, fishing, swimming, bicycling, motorcycling, hiking, driving for pleasure, horseback riding, snowmobiling, skiing, and other sports is extremely high on a per-capita basis, especially in the area of the proposed mining, the loss of opportunity cannot be equated to a percentage of the total area. It is estimated that the concentrated impact will affect 25 percent of the opportunities.

Fishing activities in the area's numerous reservoirs and lakes could be affected to a measurable extent, if adequate precautions are not taken to prevent pollution. Impacts on fisheries and related outdoor recreation activities would occur on streams, creeks, and rivers that cross or are adjacent to, and are disturbed by, mining operations. Impacts on fisheries have been previously described.

The largest adverse impacts on water-oriented outdoor recreation resources will be caused by lowering of water quality and the projected increase in the area's population. The impacts of additional fishing and hunting pressure on the resources and the need for management direction that would have to be taken to prevent fish and wildlife populations from reaching critically low levels is anticipated. With more people utilizing these resources, the need for additional law enforcement effort by the State will be needed. An attempt to control the magnitude of this type of impact will mean additonal costs. All water-based recreation activities, active and passive, will increase in demand--boating, water skiing, swimming, ice skating, fishing, picnicking, camping, and hiking. The resources and the quality of outdoor recreation experiences will be reduced unless adequate planning and precautions are implemented.

The proposed actions are not expected to impact on recreation or historic resources along the Oregon Trail, and although it crosses the Caribou National Forest, it does not appear, from available data, to be in conflict or in danger of being impacted. However, there could be adverse impacts in the future from additonal phosphate exploration mining operations, transportation and utility systems, processing plants, and changes in lease area. These impacts could occur both through destruction of historic remnants and sites and through visual degradation caused by disturbance of the natural terrain.

Pleasure driving in National Forest lands accounted for 83,600 visitor days in 1974. The proposed actions will adversely affect the aesthetics and visual quality of the area, which lends itself to driving for pleasure and other related activities. Mining operations in the region will cause loss of the natural phenomena and remoteness that have attracted so many visitors. The seclusion effects of nature and its influence on man will be permanently modified.

Mechanical means of testing, exploring, drilling, extracting, hauling, and erosion control, together with the related processing and marketing systems, will grossly alter the landscape, creating visual conflict and pollution.

5. ARCHEOLOGIC AND HISTORIC VALUES

Cultural resources are fragile and nonrenewable elements of the physical environment. Adverse impacts to these resources and their surrounding environment can occur under the following conditions: destruction or alteration of a site; isolation from or alteration of its surrounding environment; and the introduction of physical, visual, audible, or atmospheric elements that are out of character with the resource and its setting. Such impacts can damage as well as destroy the scientific, symbolic, aesthetic, recreational and/or human interest value of cultural resources.

Preliminary research studies indicate that the phosphate-mining industry would have a significant adverse impact on the existing regional environment and the cultural resources found in that regional environment. The proposed mining unit would form an alteration of the environment, which would introduce physical, as well as visual, elements that would be out of character with the historic setting of the cultural resources. The mining and associated building of haul roads, railroads, and processing plants will damage or destroy both the unidentified and the identified but unsalvaged cultural resources of the area.

The major adverse impact would be the population increase caused by the introduction of the phosphate mining unit. A large number of incoming people could cause major regional impacts on the unidentified as well as established cultural resources. For example, as public use of a region increases, so will vandalism on the cultural resources of the area. The petroglyphs found in the phosphate mining area, as well as those in the surrounding area, could be especially impacted, due to increased population and the resultant vandalism and defacement which will undoubtedly occur.

These impacts could occur at either level of mining.

6. AESTHETIC VALUES

The proposed mining will have a moderate to low impact on the aesthetics of the overall study area, but localized impacts can be high. Two of the six visual areas classified as having distinctive visual variety will be directly impacted by the proposed activities, but they are viewed by fewer visitors than the other four. The rest of the impacted area is evenly divided between common and minimal visual variety. Within the impacted areas, all elements of the visual landscape, including line, form, color, and texture, will be affected. Mine excavations and waste areas will strongly contrast with natural landforms. Roads, erosion-control devices, and utility lines will introduce foreign lines and color contrasts to the existing landscape. Impacts to texture, color, and form will result from the proposed vegetative removal and rehabilitation. Visual impacts created by proposed mines at Swan Lake Gulch, Sulphur Canyon, the foothills above Paris and Bloomington, Conda, Blackfoot Bridge, and Wooley Ridge near Henry will be mostly within the middleground viewing zones of U.S. 30 North near Swan Lake, U.S. 89 between Paris and Bloomington, and State Highway 34 near Henry and the Blackfoot Bridge. Impacts in this zone could be of major consequence. The impact along U.S. 30 North near Swan Lake will be dramatic as the result of a proposed conveyor crossing the highway in an area where long highway tangents and detailed viewing exist.

The majority of the proposed minesites are accessed by, or are in view of, secondary travel routes such as the Slug Creek, Diamond Creek, Lanes Creek, and Georgetown Canyon Roads. These routes are used mostly by visitors from the region or from the local areas. Seasonal conditions close most secondary access during the winter, except to snow machines. Fishing season, the fall hunting, dispersed camping, and driving for pleasure all bring visitors who have concern for and receive part or most of their enjoyment from the natural landscape. Activities involved with the region's mineral development will have major impact on such visitors and uses, particularly in the Blackfoot Narrows, Diamond Creek, and Henry areas.

Proposed expansion of processing activities, along with associated urban growth will have aesthetic impact through the introduction of discordant elements, such as the dust, smoke, noise, and odors usually associated with such development. These all will tend to decrease the generally clean, clear air that has been expected as a part of the environmental character of the area.

Disturbing surface and subsurface water flows (increase or decrease) with excavations, material wasting, transportation systems, will reduce the water's aesthetic quality to a potentially major degree. Increased sediment loading of streams and water bodies will make them less appealing and possibly even offensive to those viewing the total landscape.

New access roads will further increase ORV use in areas not now affected, with an attendant reduction in the visual quality of these areas.

The proposed mineral development and its supportive facilities will eliminate vegetation on 8,900 acres and reduce the wildlife habitat, which is a portion of the visually pleasing characteristic of the landscape. Reducing the potential for observing birds and animals has a negative influence on the aesthetics. Reduction in the quantity and quality of the natural streams and water bodies impact fish and aquatic plantlife and further narrow the aesthetic spectrum.

Anticipated experiences of visitors to the region are not those involving intense industrial or utility development. The existing remote range and wildlife habitat with few human influences, mostly free of pollutants, will be greatly compromised. Noise, odors, and other disturbances associated with mining and ore transporting and processing will reduce the region's aesthetics in a moderate to major range.

The visual aspects of the landcape are not compatible with extensive phosphate mineral development. All elements of the landscape will be impacted to varying degrees. Impacts are these, plus the effects that take place throughout the zones of influence. Although a mine excavation may cover but a few acres, its location atop a ridge may be seen for many miles, magnifying its impact many times. The visual quality of the water in the Blackfoot Narrows, Swan Lake, and the Blackfoot River Reservoir could be diminished. Particulates, odors, and gasses in the air will also have an area of impact. The greatest impacts result when man's influences dominate the natural environment.

In general, however, impacts within the immediate area of disturbance are moderate to major in aesthetic consequences, depending upon the viewer's location and anticipation. The study area as a whole will have only minimal to moderate aesthetic impacts.

Based on a more probable level of mining, as shown in table 1-1a, the impacts associated with the reduction in rail transportation including that in the Blackfoot Narrows, will not occur. Impacts associated with the Husky No. 1, the Caldwell Canyon, and the Blackfoot Bridge mining also will not occur. Other impacts will remain essentially the same.

CHAPTER IV
MITIGATING MEASURES

A. GENERAL

The enforcement of certain basic and significant laws and regulations will reduce or mitigate the cumulative impacts on several of the specific resource values and on the environment in general. These include:

1. The Organic Administration Act of June 4, 1897 (30 Stat. 34) (16 U.S.C. 475), established the National Forests for the protection and improvement of the forest within their boundaries and is the basic legislative authority governing the administration and management of the National Forest lands.

2. The Taylor Grazing Act of 1934, as amended (48 Stat. 1269), directed the Secretary of Interior to "do any and all things necessary to --- preserve the land and its resources from destruction or unnecessary injury."

3. The Multiple Use-Sustained Yield Act of June 12, 1960 (74 Stat. 215) (16 U.S.C. 528-531), directed the Secretary of Agriculture to develop and administer the renewable surface resources of the National Forest for multiple use and sustained yield of the several products and services obtained therefrom.

4. The National Environmental Policy Act of 1969 (85 Stat. 852), provides for a detailed environmental analysis of all major actions on Federal land and requires public input, public knowledge of, and public response to proposed actions.

5. Public Law 92-500, the Federal Water Pollution Control Act Amendments of 1972, requires through Section 313 that each Federal department or agency having jurisdiction over any property or facility or engaged in any activity resulting, or which may result, in the discharge or runoff of pollutants shall comply with Federal, State, interstate and local requirements respecting control and abatement of pollution to the same extent that any person is subject to such requirements, including the payment of reasonable service charges.

6. Section 7 of the Endangered Species Act of 1973 requires that Federal actions not jeopardize the continued existence of, or result in the destruction or modification of such habitat of such species therefore determined by the Secretary, after consultation as appropriate with the affected States, to be critical. The term "threatened species" is defined as meaning "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

7. Federal Regulation 30 CFR Part 231. The U.S. Geological Survey regulations provide for the protection of the environment during exploration and mining operations and for reclamation of lands disturbed by such operations. The operator's obligation is to "avoid, minimize, or repair" damage to the environment. The mining supervisor shall inspect the operations to determine the adequacy of water management and control of the quality of surface-water and ground-water resources and for the protection and control of air quality. The operators shall take such action as may be needed to avoid, minimize, or repair soil erosion, pollution of air, pollution of surface or ground water, damage to vegetation growth, and injury or destruction of fish. The regulations also provide that wastes from milling or processing ores from Federal leaseholds be managed in an environmentally acceptable manner.

   On December 1, 1975, new guidelines for the protection of fish and wildlife were published in the Federal Register. These guidelines prescribe procedures to be followed in review of proposals that affect navigable waterways. Permits are required from the Corps of Engineers for discharge of pollutants and disposal of other materials in these waterways.

8. Federal Regulation 43 CFR 23 requires that measures be taken to bring about the necessary reconditioning or restoration of Federal lands that have been affected by exploration or mineral development, mining or onsite processing operations, and waste disposal, in ways which will prevent or control onsite and offsite damage to the environment.

9. 43 CFR 4120 provides that all use and management of National-Resource lands outside grazing Districts (exclusive of Alaska) shall be in conformance with the concepts of multiple use and sustained yield.

10. Federal Regulations 43 CFR 4122.1, requires that all use and management practices, including grazing and the issuance of grazing leases, be in conformance with the concepts of multiple use and sustained yield.

11. Federal Executive Order No. 11514 and No. 11752, requires the Federal Government to "provide leadership in protecting and enhancing the quality of the Nation's environment."

12. The Idaho Surface Mining Act states that no operator shall commence surface mining operations without first having a reclamation plan approved by the State Board of Land Commissioners. Reclamation includes preparation of waste piles to control erosion and revegetation of disturbed areas with vegetation comparable to the vegetation that was growing on the affected beds prior to the operations.

13. The Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701), provides, for management protection and development of public land administered by the Bureau of Land Management on a multiple use and sustain yield basis while protecting the quality of scientific, scenic, and historical values, the ecological environment, and other values.

14. Idaho Code 39-118 and 42-1710 require that structures intended for or capable of storing water must meet structural standards specified under permit systems administered by the Idaho Department of Water Resources and the Idaho Department of Health and Welfare.

Normal operating policies and procedures of the agencies concerned include certain requirements that would further mitigate adverse impacts of all proposed mining operations. The most significant of these are:

1. Dust abatement will be required on all roads. Normally, this will be achieved by sprinkling with water.

2. Revegetation will be required on disturbed areas to stabilize soil, improve aesthetics, and restore production. Requirements such as special seedbed preparation methods, special seed mixtures or shrub and tree seedlings, fertilization, irrigation, and mulching will be imposed as deemed appropriate by the surface managment agency and the U.S. Geological Survey.

3. Dumps are to be shaped to blend with surrounding topography and planted with species that blend with surrounding vegetation.

4. Transportation and utility facilities will be designed and located to minimize impacts on surface resources to the maximum extent reasonable.

5. Permanent drainage systems will be required for handling water where natural systems are disrupted. Such replacement by systems must be maintenance free using present-day technology, and, as feasible, non-degrading to water quality.

6. Runoff water from disturbed areas will be routed through appropriate settling structures to stop downstream movement of most of the sediment. Complete settling of all fine sediment particles is unlikely. All water and sediment control structures shall be designed using best engineering practices and based upon adequate hydrologic Data. All such structures shall be designed to contain the maximum runoff expected during the life of the project.

7. Disturbed areas will be shaped and revegetated as promptly as possible following activity. Normally, this must be accomplished during the same field season that disturbance

occurs. Structures such as large dumps which require more than one season to construct should be built in stages to allow stabilization on the completed portion each year.

8. Existing facilities such as roads, fences, and stockwater systems, which are damaged or destroyed by mining, will be repaired or replaced if there remains a need for them in the judgment of the surface management agency and the U.S. Geological Survey.

9. Backfilling of mined pits and restoration of mined lands shall be planned and executed, to the greatest extent possible, within economic and reasonable physical, geologic, and technologic limits in a continuing effort to return mined lands to a productive status for other purposes.

10. Waste dumps will be planned, located, designed, and constructed using the best engineering technology and methods available which will assure, to the maximum extent possible, the stability of the structure while incorporating environmental soundness and acceptability.

    Surface disposal or waste dumps shall be avoided or minimized where possible. The impact of surface waste-disposal areas will be reduced by grading and shaping to blend with the natural topography.

    Waste-dump sites shall be cleared of all vegetative material before wastes are deposited. Waste-dump slopes must not exceed a maximum ratio of 3:1 to the horizontal. Wherever feasible, waste dumps should be constructed up from the bottom in horizontal layers of 12 inches or less. Dump surfaces must be covered with at least 5 feet of middle waste shales and if possible, six inches of topsoil to facilitate revegetation.

    To the maximum extent possible, waste dumps shall be located, planned, designed, and constructed to insure stability and to yield surface slopes that allow for mechanical restoration and revegetation.

    Where possible, brush barriers should be constructed to act as a sediment trap and to impede downhill waterflow.

11. Topsoil, where available, will be stripped and stockpiled from the surface of the lands to be mined or covered by dumps prior to mining. Stockpiled topsoil will be placed adjacent to the mined area and utilized as surfacing material prior to revegetation.

12. At the cessation of exploration well drilling, and after the well has been logged (by whatever method) and adequately sampled, and the test has served its current purpose, all drillholes shall be plugged with cement or concrete, or cased

and capped from bottom to top in compliance with 30 CFR 231.20(b) and (c) unless approved for monitoring by the District Mining Supervisor.

13. Waste dumps should not be placed over known areas of recharge or discharge, such as along stream channels, whenever alternative sites are practical. Springs should not be covered by dumps if alternate dump sites are practical.

14. All dumps, water and sediment control structures, and other such constructed features shall be serviced and maintained during the period of mining and for such periods these thereafter as required. Proper disposition of water and sediment control structures shall be required prior to relinquishment of a lease.

A significant mitigating measure would be the establishment of a coordinated program in the phosphate region to monitor long range impacts and provide timely data to industry, planning agencies and to agencies having regulatory authority over both mining reclamation and processing. Although many Federal, State, and local agencies and private companies now collect data for their own information and use, there exist a need for a comprehensive, coordinated program of data collection and monitoring. To meet the needs of both enforcement and planning, all key elements of the environment must be monitored. These include not only the normal air and water quality monitoring but such other sectors as wildlife, socioeconomic trends, outdoor recreation, and others. Efforts have recently been started to delineate such a program for southeastern Idaho. These efforts are continuing, but there are problems of jurisdiction, authority, and funding. A comprehensive, coordinated program, if developed and implemented, could be an important item in mitigating impacts of all types from phosphate development. The State of Idaho believes that such a program should be initiated and largely Federally-funded.

A coordinated review procedure should be developed to provide for concurrent consideration by appropriate agencies at all levels of government prior to actions on approvals of permits, leases, or mining plans.

B. NATURAL ENVIRONMENT

1. LAND RESOURCES

a. Land Surface

Measures for mitigating impacts to the land surface are described above.

In additon to Federal requirements, the Idaho Surface Mining Act, Title 47, Chapter 15, specifically requires that:

(1) "Ridges of overburden shall be leveled in such a manner as to have a minimum width of fifteen (15) feet at the top."

(2) "Peaks of overburden shall be leveled in such a manner as to have a minimum width of fifteen (15) feet at the top."

The impact of large open pits will be lessened where backfilling of the pits with waste rock is planned. The use of waste rock in backfilling also minimizes the size of waste dumps on the ground surface. The impact of waste dumps will be reduced by grading and shaping them to blend with the natural topography.

b. Geology and Mineral Resources

There are no mitigating measures for the loss of the mineral resources that are mined.

c. Soils

Significant Federal and State laws and regulations for mitigating soil impacts are discussed in Section A.

The thrust of all these requirements is that the land surface will be protected and that downstream values will not be significantly diminished by soil erosion, sedimentation, and other contaminants. The Idaho Water Quality Act, as reinforced by the Federal Water Quality Improvements Act, is perhaps the most stringent. As written, the act permits no degradation of water quality other than approved exceptions. It will not be possible to conduct large-scale mining operations without such approval.

Other measures that would help mitigate impacts on soils include testing and monitoring programs with provisions for corrective measures as required, control of off-road-vehicle use, and improved "farming" techniques. These are discussed in more detail in Parts 4 through 11.

2. WATER RESOURCES

The enforcement of all applicable Federal and State laws and regulations discussed in Section A will reduce the cumulative impacts on water resources from the proposed mining activities. In addition to these, the U.S. Geological Survey, Department of Interior, Operating Regulations for Exploration, Development, and Production, 30 CFR 231, will help mitigate impacts on surface waters through continued inspection of mining activities.

The right to use waters in Idaho is limited and regulated by the laws contained in the Idaho Code. The Department of Water Resources is responsible for permit and licensing systems which control beneficial use of Idaho's waters, and the future conservation and development of waters through planning. A right to use water for phosphate mining may be developed on any public water source which is not fully appropriated and used by other water users. It does not appear that the so-called Federal "reserved right" doctrine is applicable to water use for phosphate mining.

The Idaho Mining Act requires that an acceptable reclamation plan be submitted before mining begins. Reclamation includes preparation of waste piles to control erosion and revegetation of disturbed areas with vegetation comparable to the vegetation that was growing on the affected beds prior to the operations.

The Idaho Stream Channel Protection Act requires that stream channels be protected against alteration for the protection of fish and wildlife habitat, aquatic life, recreation, aesthetic beauty, and water quality. No alteration of any stream channel shall be made unless approval therefor has been given by the Director of the Department of Water Resources as provided in the act.

The State of Idaho, through the Department of Water Resources, regulates the disposal of materials at depths of 18 feet or more below ground surface through the Wastewell Injection and Control Act.

The Idaho Water Quality Standards and Wastewater Treatment Requirements of June 1973, administered by the Idaho Department of Health and Welfare, Division of Environment require that a comprehensive water-pollution-control program be administered to maintain as good overall water quality as possible through regulation of new or increased sources of water pollution through the highest and best degree of wastewater treatment under existing technology. Effluent standards and limitations must be met. The Antidegradation Requirement stipulates that high quality waters of the State (both surface and underground) shall be maintained at their existing high quality and will not be lowered in quality unless and until it has been affirmatively demonstrated to the Idaho Department of Health and Welfare that a change is justifiable as a result of necessary economic or social development and will not interfere with protected uses of such waters.

Also, Public Law 92-500, Section 404, charges the U. S. Army, Corps of Engineers, to regulate the discharge of dredged for fill material in the waters of the United States. As of July 25, 1975, permits from the Corps are required to dispose of dredged or fill material in manageable waters. On July 1, 1976, this requirement was extended to primary tributaries of manageable waters, and effective July 1, 1977, this requirement will be extended to all waters to the headwaters in the United States. These permits are based upon EPA guidelines as published in The Federal Register on June 10, 1976. Under the State 208 Water Quality Planning, the Southeast Idaho Council of Governments has been designated to administer the program in Bannock, Caribou, Bear Lake, Franklin, Oneida, Bingham, and Power Counties. Mining and the mining-related activities as they affect water quality, will be required to comply with this law.

Idaho Code, Section 39-118, requires that plans and specifications for the construction of new or modified waste treatment or disposal facilities (this includes mine tailings dumps) be submitted to the Department of Health and Welfare for approval prior to commencement of construction.

Public Law 93-523, the Safe Drinking Water Act, requires that drinking water provided for 25 or more people must meet national interim drinking water standards as set forth in 40 CFR 268. According to EPA and Idaho Department of Health and Welfare, those provisions relating to sole source aquifers and deep well injection are not likely to apply to the mining operations.

EPA has jurisdiction over waste-water discharge to surface streams. Pursuant to Public Law 92-500, in order to discharge to a surface water, an NPDES permit is required. This permit would be based on guidelines published in Federal Register of June 10, 1976, for Mineral Mining and Processing, which specify the effluent limitations for water dischage from phosphate mining and processing. In addition, Federal Registers of February 20, 1974, and January 27, 1975, for Phosphate Manufacturing; and Federal Registers of April 8, 1974, January 14, 1975, August 6, 1975, and May 19, 1976, for Fertilizer Manufacturing, which also apply to water discharges from beneficiating and other processing associated with phosphate mining, will serve as quidelines.

Enforcement of these laws, together with natural factors, will help to mitigate impacts on the water resources, such as increased sediment loads, nuisance algal blooms resulting from such nutrients as phosphorus and nitrogen, and significant increases in potentially toxic and radioactive elements and other contaminants.

Other mitigating measures should include adequate monitoring of stream water quality. Parameters measured should permit characterization as to kinds and amounts of solutes (dissolved substances), streamflow characteristics, size distribution and concentrations of sediments, and sediment-solute relations. Stream water-quality monitoring should also include biological assessment of changes in numbers and kinds of aquatic organisms to be used as indicators of pollution.

It should be a standard practice to monitor water levels and quality in areas where extensive ground-water systems are affected by mining. Observation wells should be placed in or near backfill areas to monitor possible leaching of toxic materials from the backfill and movement of water through the ground from the backfill areas. Observation wells should also be placed near settling and evaporation ponds to monitor possible seepage of contaminated water from the ponds into the ground-water system. All ponds associated with processing that contain water having objectionable concentrations of toxic elements must be sealed and protected from floods that might allow escape of the contaminated pond water.

Sediment control devices should be designed to accomodate an event of specified recurrence frequency on the worst likely condition (the Forest Service recommends designing for a 75 year event), with provisions for a maintenance and cleaning program, and conditions and procedures for abandonment.

3. AIR RESOURCES

The U.S. Environmental Protection Agency and the Department of Health and Welfare of the State of Idaho have established the following standards that define acceptable ambient concentrations of air contaminants consistent with established air quality criteria. Primary standards define the air quality which, allowing an adequate margin of safety, is requisite to protect the public health. Secondary standards define the air quality which is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of air pollutants in the ambient air. The following standards are taken from the Rules and Regulations for the Control of Air Pollution in Idaho effective January 3, 1975:

Particulate Matter

A. Primary air-quality standards are:
   1. 75 micrograms per cubic meter - annual geometric mean.
   2. 260 micrograms per cubic meter - maximum 24-hour concentrations not to be exceeded more than once per year.

B. Secondary air-quality standards are:
   1. 60 micrograms per cubic meter - annual geometric mean.
   2. 150 micrograms per cubic meter - maximum 24-hour concentration not to be exceeded more than once per year.

Sulfur Oxides (Sulfur Dioxide)

A. Primary air-quality standards are:
   1. 80 micrograms per cubic meter (0.03 ppm) - annual arithmetic mean.
   2. 365 micrograms per cubic meter (0.14 ppm) - maximum 24-hour concentration not to be exceeded more than once per year.

B. Secondary air-quality standards are:
   1. 1,300 micrograms per cubic meter (0.50 ppm) - maximum 3-hour concentration not to be exceeded more than once per year.

C. When more than one standard is applicable, the interpretation that results in the most stringent standard shall apply.

Photochemical Oxidants

A. Primary and secondary air-quality standards are:
   1. 160 micrograms per cubic meter (0.08 ppm) - maximum 1-hour concentration not be be exceeded more than once per year.

Hydrocarbons

A. Primary and secondary air-quality standards, as measured and corrected for methane, are:
   1. 160 micrograms per cubic meter (0.24 ppm) - maximum 3-hour concentration (between 6 a.m. and 9 a.m.) not to be exceeded more than once per year.

B. The hydrocarbon air-quality standard is for use as a guide in determining hydrocarbon emission control required to achieve the photochemical oxidant standards.

Nitrogen Dioxide

A. Primary and secondary air-quality standards are:
   1. 100 micrograms per cubic meter (0.05 ppm) - annual arithmetic mean.

Carbon Monoxide

A. Primary and secondary air-quality standards are:
   1. 10 milligrams per cubic meter (9 ppm) - maximum 8-hour concentration not to be exceeded more than once per year.
   2. 40 milligrams per cubic meter (35 ppm) - maximum 1-hour concentration not to be exceeded more than once per year.

In addition to the above pollutants regulated by State and Federal agencies, the Department of Health and Welfare of the State of Idaho also has established standards for the following pollutants.

Settleable Particulate

A. Primary and secondary air-quality standards are:
   1. 0.8 milligrams per square centimeter per month not to be exceeded more than 25 percent of the time.

Sulfuric Acid Mist

A. Primary and secondary air-quality standards are:
   1. 12 micrograms per cubic meter - maximum 24-hour concentration not to be exceeded more than once per month.
   2. 30 micrograms per cubic meter - maximum 1-hour concentration not to be exceeded more than twice per week.

Fluorides

A. Primary and secondary air-quality standards are those concentrations in the ambient air which result in a total fluoride content in vegetation used for feed and forage of no more than:
   1. 40 parts per million, dry basis - annual arithmetic mean.

2. 60 parts per million, dry basis - monthly concentration for 2 consecutive months.
3. 80 parts per million, dry basis - monthly concentration never to be exceeded.

Beryllium

A. Primary and secondary air-quality standards are:
   1. 0.01 micrograms per cubic meter - maximum 24-hour concentration not to be exceeded more than once per year.

The regulation for the control of particulate emissions from industrial processes is based on the processing rate. Production rates applicable to the phosphate processing plants and the corresponding allowable particulate emission rates are shown in table 1-46. Regulation R, however, does not apply to determining the emission rate for sulfur dioxide at Beker and Simplot plants. Beker currently (January 1976) is operating under a consent order from the Idaho Division of Environment limiting SO_2 emissions to 27,000 pounds per day. The J. R. Simplot Company's acid plants are regulated by a new regulation, promulgated in June 9, 1976, which replaces Regulation R (Federal Register, v. 41, no. 112, CFR 52.675). This regulation is designed to assure attainment of NAAQS, but will not leave a margin for growth unless further controls are applied to reduce total emissions. Any new or modified sulfuric-acid plant would be subject to the Federal and State standards of performance for new sulfuric-acid plants.

Fluoride emissions are regulated to prevent the accumulation of fluorines in feed and forage for livestock at levels greater than the ambient air-quality standards pertaining to fluorides.

Allowable increase limitations where National Ambient Air Quality Standards (NAAQS) are not presently being violated for SO_2 and total suspended particulates are regulated by "Prevention of significant air quality deterioration" (40 CFR 52.21, Federal Register, v. 39, no.235, December 5, 1974, as amended June 12, 1975). These regulations allow States, Federal Land Management and Indian Tribes to designate areas as class I, II, or III as to deterioration increment, and define the classes as follows:

> "Class I applied to areas in which practically any change in air quality would be considered significant.
>
> Class II applied to areas in which deterioration normally accompanying well controlled growth would be considered insignificant; and Class III applied to those areas in which deterioration up to the national standards would be considered insignificant."

These allowable incremental increases in SO_2 and particulates may well be the most restrictive environmental standards that any new or modified phosphate plant must meet.

Table 1-46. ALLOWABLE RATE OF EMISSION BASED ON PROCESS WEIGHT RATE 1/

Process Weight Rate Tons/Hr	Rate of Emission Lb/Hr	Process Weight Rate Tons/Hr	Rate of Emission Lb/Hr
0.05	0.55	8	16.5
0.1	0.89	9	17.9
0.2	1.40	10	19.2
0.3	1.83	15	25.2
0.4	2.22	20	30.5
0.5	2.58	25	35.4
0.75	3.38	30	40.0
1.0	4.10	35	41.3
1.25	4.76	40	42.5
1.5	5.38	45	43.6
1.75	5.96	50	44.6
2.0	6.52	60	46.3
2.5	7.58	70	47.8
3.0	8.56	80	49.0
3.5	9.49	100	51.2
4.0	10.4	500	69.0
4.5	11.2	1,000	77.6
5.0	12.0	3,000	92.7
6.0	13.6		

1/ Interpolated

The regulations also state that areas that are "pervasively above any national standard for particulate matter or sulfur dioxide" are exempt from this regulation, since there could be no allowable incremental increase in air quality for an area that must decrease air quality in order to attain national standards. The following table shows the allowable increases in particulate and sulfur dioxide by classes I and II as published in the regulation. The eastern Idaho region could involve either class I or II (as currently being considered). Class standards have not been established for fluorides, which are under the State of Idaho standards. The two plants that are in violation in 1975 for sulfur dioxide, and the one plant in violation for particulates in 1975, however, do not come under the new classifications.

AREA DESIGNATIONS BY CLASSES SHOWING LIMITATION IN POLLUTANT CONCENTRATION INCREASES

Pollutant	Class I Micrograms/m^3	Class II Micrograms/m^3
Particulate Matter		
Annual geometric mean	5	10
24-hr maximum	10	30
Sulfur dioxide		
Annual arithmetic mean	2	15
24-hr maximum*	5	100
3-hr maximum*	25	700

* Only second highest concentration should be considered. See Federal Regulations 40 CFR 52.21 (b)(1).

The control of fugitive emissions can be approached with several methods. The best control strategy is to confine the emissions. However, that is often not feasible for fugitive emissions from holding areas or during transportation. One approach that can be used for this problem areas is to construct wind barriers to halt the transport of the pollutant. Well-designed wind barriers can be useful when high winds from a predictable direction are the major cause.

Fugitive emissions from holding ponds, such as fluorine, are a more difficult problem to solve. Several intermittent approaches, however, can be conceived that involve the reduction in size, temperature, or fluorine content of the holding ponds during the growing season when air-quality standards are generally applied for fluorine.

Particulate emissions from existing chimneys are normally controlled through the use of precipitators, scrubbers, and bag houses. If the particulate concentrations, after the best available constant-control methods are applied, exceed air-quality standards during certain periods, an intermittent-control strategy can be devised that will prevent the air-quality standard from being exceeded. Generally, this strategy would be applied during stagnation episodes when the 24-hour standard is most likely to be exceeded. Violations of the annual particulate standard need to be resolved first by an increase in the efficiency of constant control systems. After the best available technology has been employed, other approaches in addition to the efficiency increase can utilize an increase in emission height or selective intermittent control during particularly high-impact periods.

There exist 3-hour, 24-hour, and annual standards for sulfur dioxide that apply to the SO_2 emissions from the phosphate industry. The SO_2 emissions are usually controlled by constant-control systems generally employing wet scrubbers. Some of the older sulfuric-acid plants are not controlled either by a wet scrubber of a double contact process. Some of the new sulfuric-acid plants are double adsorption plants. When these methods have been made as efficient as possible and air-quality standards are still being exceeded, an increase in emission height or an intermittent-control strategy needs to be considered.

The control of fluorines under present air-quality standards is largely seasonal, thus lending itself to intermittent control. However, increases in release height should be investigated as a first step toward annual control since present standards are concerned only with effects on vegetation and may be modified. The intermittent-control strategy can be applied in two ways. The first would be to curtail emissions only during high-impact times on a daily basis. The second method would involve a partial production cutback during the growing season.

The control of emissions directly from the mines presently utilizes water or chemjet spraying for control of road and mine dust and revegetating waste dumps to control wind erosion. Such methods should be continued and re-evaluated periodically as to their effectiveness at controlling emissions.

Both State and Federal policy is to apply best available technology for control of emissions rather than to provide for wider dispersal through the atmosphere.

An interpretation of the Clean Air Act with regard to stack height increases and supplementary control systems was published subsequent to issuance the draft EIS. On February 18, 1976, EPA published in the Federal Register (v. 41, no. 33, pages 7450-7452) the agency's "Legal Interpretation and Guidelines to Implementation of Recent Court Decisions on the Subject of Stack Height Increase as a means of meeting Federal Ambient Air Quality Standard." As stated in the introduction, "...Congress did not intend increased stack height and Supplementary Control Systems to be used as a means of attaining national ambient air quality standards where constant emissions reduction controls were available." Based upon these guidelines, constant emission controls must be used to reduce air pollution.

4. VEGETATION

The enforcement of all applicable Federal and State laws and regulations listed in Section A will reduce the impacts on vegetation from the proposed mining activities in the study area. In addition to general laws, application of 43 CFR 4122.1, which requires that all use and management practices, including grazing and the issuance of grazing leases, be in conformance with the concepts of multiple use and sustained yield, will have mitigating influence on vegetative resources.

The following additional measures, applied where determined to be appropriate on a case-by-case basis by the USGS and the surface-management agencies, will further mitigate potential adverse impacts of the proposed actions:

Compacted soils shall be ripped and scarifed to enhance water and root penetration. Soils shall be analyzed for essential mineral elements to determine if fertilization will be required for plant establishment. The soils shall be tested for microbial content and should be injected or treated on an individual basis to aid the soil-building process as well as the essential mineral-element availability for plant growth.

Native species shall be used to the maximum in the revegetation program. At least 40 pounds per acre of recommended grass and forb seed shall be used. Grass and forb plantings shall be done in the fall on a planned yearly progression to take advantage of moisture availability and to minimize the amount of land not covered by vegetation at any given time. Sprinkling with water during initial planting periods may be necessary in the plant-establishment process. Sources of seed should be as near the rehabilitation site as possible. hould Reseeding should be done by drilling on the contour as much as possible.

Conifer-tree seeding should be planted experimentally but only after soils have stabilized. The most conducive areas for this would be on north- and east-facing slopes. Revegetated areas might have to be protected from grazing for at least two growing seasons to allow vegetation to become established.

Revegetation attempts shall be continued until the revegetation meets the satisfaction of the surface-management agency and the U.S. Geological Survey. Backfilling and revegetation of pits will also mitigate impacts on vegetation.

5. WILDLIFE

Enforcement of existing Federal and State laws and regulations described in section A will help mitigate the impacts on wildlife.

In addition to these laws, Section 36-104 of the Idaho Code provides authority for the Idaho Fish and Game Commission to acquire State and private lands and waters for fish and wildlife management.

Company-proposed mitigating measures deal largely with revegetation and fencing. These are discussed in detail under the appropriate mining plans. Additional mitigating measures applied on a case-by-case basis, as deemed feasible by the land-management agencies and the USGS, include the following:

Mine dumps proposed on critical wildlife habitat areas, as identified in the site-specific mining plans, shall be relocated to less critical wildlife habitat areas where feasible.

Buffer zones shall be left wherever possible between transportation facilities and riparian habitats or marshes. Also, where crossings are necessary, all roads and railroads shall cross streams at right angles to minimize habitat impacts.

Springs and other water sources shall be developed for mining operations in such a manner as to allow sufficient water for wildlife and not drain wet meadows.

Removal of Douglas fir or other trees to facilitate mining or mining-associated activites shall be kept to a minimum to help maintain habitat for wintering spruce grouse; to maintain perches and nesting areas for eagles, other raptors, and migrating songbirds; and provide food, nesting, and cover sites for many wildlife species.

Fences and powerlines shall be constructed in accordance with BLM and Forest Service specifications.

Studies should be initiated to determine the specific locations of major deer and elk travel lanes. After these major big-game migration corridors have been identified, wing fences, underpasses, bridges, and other structures could be developed to facilitate big game movements to reduce collisions between big-game and vehicles. Studies should also be initiated to further define critical habitat of threatened and endangered species that may inhabit the area.

Wing fences, underpasses, and bridges to facilitate deer migration movements and to reduce accidents shall be developed in conjunction with the Idaho Fish and Game Department where transportation corridors are widened or constructed. Trees and shrubs planted about 50 feet from the corridors would help recover some of the wildlife habitat lost through highway development.

In addition to the above, the Idaho Department of Fish and Game recommends that the following projects be initiated at an early date.

Long-term biological studies on specific fish, wildlife and habitats should be initiated to identify problem areas and to provide specific information and recommendations to regulatory agencies and mining companies for purposes of adjustments in operations that would reduce impacts.

Private and Federal critical game ranges should be acquired and enhanced to compensate for important areas altered or removed by mining operations, to offset delays in long-term rehabilitation of mine dumps and pits.

Off-stream ponds and impoundments should be developed to provide additional fisheries, waterfowl habitat and watering areas. Such areas should be fenced to insure minimum disturbance.

Acquisition of Rights-of-way and access to public lands should be acquired for better game management.

Increased costs of providing additional enforcement effort in the area should be offset by additional resources.

Provision should be made to compensate for any fish losses that may occur as a result of mining and processing operations and related activities.

The Idaho Department of Fish and Game suggests that funding for these measures could be obtained from the following sources: (1) an increase in the existing 50 percent royalty that is presently being paid to the State of Idaho. This increase to be assigned specifically to the State for fish and wildlife mitigation, compensation and enhancement for losses incurred as a result of Federal action, (2) a special tax on tons of phosphate ore removed to be paid directly to the Idaho Department of Fish and Game to administer management programs designed to reduce or compensate for losses, (3) direct Congressional appropriation, or (4) increases in annual budgets to Federal land management agencies responsible for approving permits, leases and mine plans to assist in carrying out reasonable and effective mitigative and enhancement programs.

The Idaho Department of Fish and Game also recommends the following mitigating measures be adopted:

1. Special zoning to prevent intensive housing development close to the proposed new mines should be adopted to maintain the integrity of fish and wildlife use areas.

2. Adjustments in livestock grazing permits, licenses or leases in critical wildlife areas should be made to insure ample food, cover, water and space to compensate for habitat losses incurred by mining and related activities.

3. Fences should not be constructed parallel to ridge tops along hillsides except in areas specifically designated to prevent big game intrusion.

4. Designated road closures should be implemented in areas where roads have been constructed into important wildlife areas. Permanent road closures should be followed with a revegetation program.

5. Mining and associated activities should be restricted or curtailed in specific areas during critical periods of the year when such disturbance would result in abandonment or reduction of use of wildlife using the area.

Because the fish and wildlife resources are the property of the State and because the State has only limited authority to control the impacts of the proposed Federal actions, the Idaho Fish and Game Department believes that additional specific Federal legislation and appropriations be provided to compensate for wildlife losses and that adequate funding be provided for essential mitigation.

6. FISHERIES

The main Federal laws and regulations regulating the degree to which aquatic environments can be protected are listed in section A.

The major State laws that protect aquatic resources are the Water Quality Standards and Wastewater Treatment Requirements (1973), and the Stream Alterations Law which specify minimum concentrations of most accelerated water additives from land and water uses, and limit direct effects such as water-temperature influences; the Idaho Water Laws and Regulations, which govern water rights, water use, and preservation of the quality of surface waters, and authorize a board to establish water-quality rules and regulations for fisheries values; and the Idaho Fish and Game Code 36 which establishes protection measures and addresses certain types of pollutants that enter streams, lakes, reservoirs, and ponds.

These Federal and State laws, if enforced, will help alleviate the impacts to aquatic resources. Because they do not adequately control all damage, intensive management will be required to minimize damages due to accidents, unusual storms, and management errors.

The following mitigation measures, applied on a case-by-case basis as determined appropriate by the land-management agencies and USGS, would further protect and enhance the fisheries in streams, lakes, reservoirs, and ponds. Proposed mine dumps covering or interfering with streams or other waters should be relocated. Riparian habitats should receive special attention, and their uses should be intensively managed. The degree of loss of perennial water in springs or streams should be analyzed prior to mine-plan approval; all water sites developed for mining purposes should be evaluated for possible fishery benefits; and those fisheries of importance should be fenced for animal control. Water from waste dumps, open-pits, or other disturbed areas should be contained or treated prior to release into any natural waters.

Mining companies have recognized the detrimental impacts to water resources that can result from poor mining and processing practices. Even with the best known methods available today, the aquatic-fisheries resources may be inadvertantly impacted, and Federal, State, and county laws may be inadvertently violated through unforeseen events.

To meet this problem, some companies are planning to minimize or compensate aquatic-fisheries damages whenever possible; some propose to backfill open pits, to create new lakes, ponds, or reservoirs, and to protect riparian vegetation. Operational and environmental provisions to lessen impacts include conventional soil-erosion practices and stream-sedimentation controls during and after actual mining operations, and some companies will place most of their mine wastes in safe-containment areas.

7. RADIOLOGIC IMPACTS

Enforcement of State regulations (Amendment of Part 1, Idaho Radiation Control Regulations) to prohibit the use of slag in the construction of habitable structures will mitigate the radiological hazard to occupants of such structures.

Implementation of an expanded State of Idaho/EPA radiological monitoring and enforcement program to cover all aspects of phosphate mining, processing, and land reclamation would mitigate significant radiological impacts to the region. The program should include samplings of radioactivity of nearby aquifers, water runoff, air, and vegetation in reasonable proximity to mining and processing operations. It also should consider possible radiological impacts on occupational workers with respect to respiration of dust particles, radon, or radon daughter products.

Remedial actions to minimize the radiological impact of gypsum-pond dike failures which might result from earthquake or structural weakness would mitigate the possible contamination of adjoining surface waters and aquifers. Consideration also should be given to possible contamination of surface and ground-water by gypsum-pile runoff, erosion, seepage, dewatering, or deep-well injection.

C. CULTURAL ENVIRONMENT

1. AGRICULTURE AND RANGE

The enforcement of all applicable Federal and State laws and regulations will minimize the impacts of proposed mining activities on vegetation as well as agriculture and range. Specific laws and regulations which will mitigate impacts to agriculture and range are:

43 CFR 3500 Leasing of Minerals Other Than Oil and Gas
30 CFR part 231; USGS Mining and Reclamation Plan Approval
Federal Water Pollution Control Act
43 CFR 4120; Grazing Administration outside Grazing District
Idaho Water Quality Standards and Wastewater Treatment Requirements (1973).
Idaho Water Laws and Regulations

Under these laws and regulations, the mining companies are required to submit complete mining and reclamation plans for approval by the U.S. Geological Survey and the State of Idaho. Mitigating measures not covered under the mining and reclamation plans should be included as special terms and conditions to approval of the mining and exploration plans proposed.

Of the 16 proposed mining plans, only 1 is for a completely underground operation, and its mitigating measures include revegetating surface-disturbed areas when they are not needed for ongoing operations. If subsidence occurs on the surface area during the life of the lease, the land will be fenced and signed to protect wildlife, livestock, and humans. Specific mitigating measures must be determined on a case-by-case basis.

Mitigating measures for haul roads, access roads, and rights-of-way are generally alike in all mining plans. These disturbed areas will generally be dressed back to as natural a condition as possible and will be reseeded following termination of mining or at such time as they are not needed for ongoing operations.

Many, if not all, of the impacts of mining and processing on agricultural and range could be mitigated through such measures as range improvements on areas not affected, the purchase of cattle or other property and subsidation of local operators for costs incurred.

Expanded or new processing plants emitting fluorine and other pollutants injurious to livestock must install the required and essential control facilities necessary to maintain fluorine levels below the 40 ppm as required by law.

The State of Idaho believes that other mitigating measures could be followed, such as: purchase of grazing permits, purchase of cattle, installing range improvements which would increase forage supplies in areas not affected and subsidizing existing operators for losses incurred.

2. SOCIOECONOMIC DEVELOPMENT

The most significant general mitigating actions that might be taken are a wider dispersion of population beyond the three counties of primary impact, intergovernmental cooperation in planning and assessment of regional needs, and the availability of additional financial resources to assist in funding public-service programs.

The dispersal of incoming population over a broader area beyond the three counties of primary impact may occur as a consequence of private decisions and actions. The problem of population dispersal will be critical in Caribou County. Population dispersion may not be effective as a mitigating measure unless Caribou County employees will reside in the northern regional communities of Pocatello and Chubbuck in Bannock County, American Falls in Power County, and Blackfoot in Bingham County.

A planned population dispersal would involve a system of mass transportation. The costs involved in establishing such a system indicate that subsidies by government and/or the mining companies would be necessary to make a project of this kind economically feasible. The Southeast Idaho Council of Governments has proposed that a public system of mass transportation be created under the Rural Highway Public Transportation Demonstration Program. The system would collect and transport employees to mining and ore-beneficiating and processing sites from throughout the region, including several counties in southeast Idaho and northern Utah. The system would be funded by a combination of resources from the Federal Government, employee-users, and mining companies. The company's subsidy would be in lieu of constructing extensive parking areas in the mining and processing locations. The public transportation system would serve as a mitigating factor for adverse environmental effects resulting from the construction of parking areas and the possible consequences of termination of production, if it should occur either during the forecasting period or after the year 2000. In short, the public transportation system would mitigate the social impacts during operation and any consequences associated with abandonment.

A second general mitigating factor consists of intergovernmental cooperation for the purposes of planning and assessment of regional needs. The planning capabilities vary among local governments in the counties of primary impact. All three counties--Bannock, Bear Lake, and Caribou--have active planning and zoning commissions. These commissions do much of the planning for smaller cities in Bannock and Bear Lake Counties where planning commissions have not yet been created. Only Bannock County and the City of Pocatello have full-time planning staffs in the three counties of impact, although some officials in other governments accept responsibilities for planning as part of their official duties.

The lack of professional staff to assist local officials in planning in the impacted counties is compensated for partly by the Southeast Idaho Council of Governments (SICOG) and the Bear Lake Regional Commission. SICOG assists local governments with grant applications for Federal support, feasibility, and needs studies. In the fall of 1975, SICOG will provide, in cooperation with the Government Research Institute at Idaho State University, student interns to assist cities and counties in preparing comprehensive plans. The local assistance component of the Idaho State Division of Budget, Policy Planning, and Coordinations maintains a field representative in Pocatello who can make available resources of the division to assist local governments in planning.

However, the dramatic impact which the proposed action will have on Caribou County and, together with the plant siting by Bucyrus-Erie, on Bannock County would appear to justify an intergovernmental assessment of estimated social-service needs. An evaluation might be made similar to that conducted of the impact caused by establishing the Trident Support Complex in Kitsap County, Washington. Several Federal agencies projected costs for providing services to the area of impact. Idaho law does not permit local governments to enact such taxes. Local leaders might attempt to work through their representatives to the State legislature in order to secure State authorization for such a tax. The problems faced by Rock Springs, Wyoming, which experienced an increase in population from 11,000 to 27,000 in 3years, were made somewhat more manageable when the Wyoming State Legislature enacted a law allowing a local sales tax and Rock Springs immediately adopted it.

A third source of financial assistance may be available to the three impacted counties under Title IX of the Public Works and Economic Development Act of 1965. A 1974 amendment to this act provides special economic development and adjustment assistance programs for states and local areas. The aid can be used to develop or implement a comprehensive program of adjustment to an actual or threatened economic dislocation or adjustment problem. Among the problems the program is designed to assist are those involving "severe changes in economic conditions." The impacted counties are eligible for assistance under this act because of their membership in SICOG, which has been designated an economic development district under the provisions of the act. SICOG has applied for planning funds to develop an adjustment strategy that would involve one or more of the specific activities that may be implemented by Title IX. These activities include: construction of public facilities, public services, business development, planning, unemployment compensation, rent supplements, research, technical assistance, training, and other appropriate assistance.

The development of public services will be hampered by fiscal lag. An example of how this lag affects financing is available in the area of education. Because receipt of property tax revenues tends to lag behind the increase in population by as much as 12 months, it may be difficult to expand some services in the early stages of the expansion period. Additions to the teaching staff in the local school districts will probably be necessary soon after construction of the proposed phosphate development begins, which will probably require funding above that immediately available from property tax revenues. An important mitigating factor here is the state assistance to local school districts. This financial arrangement will tend to ease the expected burden on the local school districts, but it should not be expected to eliminate the short-term financing problems.

The location of additional plant facilities outside Bannock County will create permanent fiscal hardships on the people of School District 25. While additional processing facilities in Bear Lake and Caribou Counties will broaden the property tax base in those areas, general property tax increases may be necessary to cover the increased requirements of new and expanded facilities and public-service programs. It is expected that the fiscal lag will affect other areas including law enforcement, utilities (sewer and water), and health services.

Recently enacted Federal and State laws relating to the distribution of receipts from Federal mineral leases will provide some financial assistance. As of August 4, 1976, 50% of moneys received from mineral leasing royalties, rentals and bonus bids goes to the state. Of this, 10% is remitted to the counties from which the resources were extracted for construction and maintenance of public roads or for the support of public schools.

The impacts of the proposed action will strengthen proposals for national and state assistance originating from the counties where the development will occur as well as the region as a whole. Community support for increased bonding assessments will be more favorable as the pressures of increased population become evident. Although rapid population and employment growth are necessarily accompanied by a number of problems, some factors inherent in the economic development process might, in a sense, be considered a mitigating factor. In Bear Lake County, for instance, the problems of above-average unemployment and relatively low wage levels will be mitigated by the proposed action. It is possible that some of those affected by the problems will find the disutility associated therewith to be small relative to the economic benefits. In general, many area residents will benefit from an increase in real income and an expansion of their range or choice in terms of new employment opportunities and goods and services available to them in the area.

The adverse effects of rapid growth in housing in the three counties may be mitigated by the following factors. First, the immediate demand for housing will be satisfied in part, at least during construction periods, by the workers themselves. The majority of such workers are transient and many, anticipating a shortage of housing in the Bear Lake and Caribou county settings, will provide their own housing in the form of mobile homes or trailers. Others will commute during the construction period. Employers are advised, however, that reliance on such makeshift arrangements of housing beyond the construction period will affect the stability and dependability of the work force and the capacity to attract qualified personnel.

Second, on July 1, 1975, the "Local Planning Act of 1975", enacted by the Idaho Legislature, became operative. This act requires that each city and county prepare a comprehensive plan, adopt a subdivision ordinance, and negotiate an area of city impact. Cities and counties may act separately or through a combined jurisdictional form such as a joint city-county planning commission. The comprehensive plan must cover the following areas unless it specifies why any are unneeded: population, economic development, land use, natural resources, hazardous areas, public facilities or services, utilities, transportation, recreation, special areas or sites, housing, community design, and implementation. Existing comprehensive plans must be updated by January 1, 1977, and zoning and subdivision ordinances must be adopted or amended by January 1, 1978. Of the three counties, only Bear Lake currently has no zoning or subdivision ordinances. Neither Bear Lake or Caribou County currently has a mobile home ordinance. Compliance with the new law will enable local offícals to more effectively anticipate and plan for problems associated with growth.

Third, the development of housing units by individuals or large developers, within or outside city limits, must comply with State regulations and standards governing sewage-disposal systems, water quality standards, and wastewater treatment requirements. Rules and regulations for individuals and subsurface sewage-disposal systems were established in 1971 pursuant to Title 39, Chapter 1 of the Idaho Code, Sections 39-106, 39-112 and 29-116, and in compliance with Senate bills 1197 and 114, which were passed in 1971. The rules and regulations in Idaho are administered and enforced by the Environmental Services Division of the Department of Health and Welfare and through regional health districts.

The rules require that a permit be acquired by any individual before an individual sewage system is constructed, altered, or extended. In issuing a permit, the state authority must ensure that standards are met with respect to wastes discharged to various individual and subsurface sewage-disposal systems.

A subsequent publication issued in 1973 contains regulations and standards for water quality and wastewater treatment which were established in 1973 in accordance with Title 39, Chapter 1, Idaho Code, Title 67, Chapter 52, Idaho Code and Chapter 87, Idaho Session Laws, 1973. Titled Water Quality Standards and Wastewater Treatment Requirements.

An immediate impact of economic growth is a rise in property values, usually due to speculation. The cost of housing rises, both rental and purchase. This places an economic burden on individuals and families with low and moderate incomes, and especially the elderly with fixed incomes. The Farm Home Administration (Section 515, Multifamily Housing) administers a rural rental housing loan program which provides credit to develop housing for senior citizens and people with modest incomes. Qualified recipients pay rent at a subsidized rate. The only units constructed under this program in the eight-county region are located in Bingham County.

A second Federal program exists to assist renters. The Department of Housing and Urban Development (HUD) has allocated funds to construct units for low-income renters in Idaho under the Housing and Community Development Act of 1974 (Public Law 93-363). The Idaho Housing Agency, which administers the statewide program, has allocated 50 units to the City of Pocatello for the current fiscal period. This construction will aid low-income families who will pay between 15 and 25 percent of their adjusted family income for rent. Also allocated through HUD are rent supplement funds to assist low-income persons directly. The amount of $97,000 has been allocated for such assistance in the SICOG region during the current year. It is estimated that approximately 51 families will be assisted with these funds. A recent housing report revealed that 26.75 households in the SICOG region were expending more than 25 percent of the family income for rent in 1970.

These Federal programs offer the possibility of mitigating the anticipated impact of greatly increased rents for low-income families. However, at present levels of funding and operation, these programs will have a minimal effect upon anticipated rent increases for low-income and elderly families and individuals.

By the year 2000, all of the school districts in Bannock, Bear Lake and Caribou Counties, with the exception of the Grace School District, will have to undertake some form of facilities expansions to accommodate the natural growth of student population supplemented by the additional growth brought about by the development of the region's phosphate resources. Various circumstances and actions could mitigate the impact of the costs of this expansion. The school districts could attempt to absorb this increased student population by increasing class size; however, given the projected increase in student enrollment by 2000 in Marsh Valley, Pocatello, and Soda Springs, this alternative appears ineffectual in the long run. The school districts could attempt to accommodate the increased student population by operating double sessions. Again, from the size of the projected increases, it appears that the long-run adjustments will be in the form of increased facility capacity which entails construction of new schools or additions to existing ones.

If student-teacher ratios of 25:1 in the elementary grades and 30:1 in the secondary grades are to be achieved, then there is little chance of mitigating the impact of the need for increasing school facility.

If the population split among the school districts in Bannock and Caribou Counties does not conform to the projections made in this study, some pressure may be relieved in some districts and increased in others. For example, if the percentage of population distribution between Pocatello and Marsh Valley School Districts is 75-25, rather than 90-10 as projected, the projected pressure from increased student enrollment would increase in the Marsh Valley District and decrease in the Pocatello School District.

Population disbursement would relieve demand on the school districts in counties of primary impact. If transportation accommodations, either public or private, are available to allow the population impact to extend outside these counties, this would be reflected in a more even demand on the school districts throughout the SICOG and eight-county region and a decrease in the pressure on the school districts in Bannock, Bear Lake, and Caribou Counties.

Another mitigating measure is the effect on the local property tax base of the phosphate mines. Not all districts would be aided, but in those districts where mines are located the net profits mining tax (Idaho Code 63-2801, 02, 03) will add the profit earned after allowable deductions to the property tax base for taxing units.

School districts may levy their 27 mills for maintenance and operation against that added tax base. It affects the state Foundation Program formula for state funding of public school education as well.

However, it is expected that initially there will be little profit after allowable deductions as the initial investments of the mining companies are paid off.

Another mitigating measure is the increase in Idaho's share of money from Mineral royalties and leases. It is anticipated that share will total over $1 million in 1976-77. Of that total, 90 percent (or an estimated $990.000 during the "76-77 school year) will go into the Public School Income Fund for distribution through the Foundation Program to all of Idaho's 115 school districts. The remaining 10 percent, as of the last session of the Idaho Legislature, is returned to the counties where the revenues are generated. It then is up to the county commissioners to distribute that money among all the public service agencies in the locale, including school districts. The total dollars from Idaho mining royalties and leases is expected to double in 1977-78, however most of this increase is not due to phosphate so revenues will not necessarily return to counties impacted by phosphate development.

Changing the state's distribution of the Mineral royalties and leases money through the Foundation Program formula is a possible alternative short term financing solution.

There is probably little chance of mitigating the impact of increased population on such health factors as infant mortality, leading causes of death, incidence of mental illness, and communicable diseases. The most common, and not illogical response, to the impact in these health areas is to seek to increase health services to keep these factors within limits the community can accept; as the comparative tables have shown, these tolerable limits are most often defined in terms of national or regional rates or rations.

It is difficult to project the mitigation of the demand for increased health services and facilities. In capital expenditures, for example, the efficient operation of home health care service would permit patients who are not sufficiently ill to require hospitalization, or do not require further hospitalization, to receive the health care they need in the home. Such a service could be expected to mitigate some of the need for additional general hospital bed capacity. If new programs were adopted, such as a full-coverage national health insurance plan, the relief achieved through some health care service would be neutralized.

Another consideration that could mitigate the demand for capital expansion would be the evaluation of studies conducted by the Department of Health and Welfare relative to health needs. An example is a Health and Welfare regional study, which concluded that 60 percent of the current medicaid patients in existing nursing homes require only intermediate care. If this is so, the projected need for nursing home capacity in the SICOG and eight-county region could be considerably reduced.

Increased cooperation among local law enforcement agencies and authorities can maximize available resources and avoid duplication of specialized positions required by local agencies.

In addition, state, local, and national laws could be changed (e.g. the basis upon which Federal in lieu payments are returned to counties) such that the beneficiaries of this development are forced to bear a major portion of the costs being imposed. If policies with this objective were implemented, many of the adverse socioeconomic effects could be mitigated. These resultant policies would however, result in an increase in the price of extracting phosphate in the area.

3. TRANSPORTATION AND UTILITIES SYSTEMS

Highway improvement policies have been formulated by both the Federal Government and the State of Idaho.

Part (a) of Title 42, United States Code, Congressional Declaration states: "The Congress hereby declares that the general welfare, the economic growth and stability of the Nation and its security require the development of national transportation policies and programs conducive to the provision of fast, safe, efficient and convenient transportation at the lowest cost consistent therewith and with other national objectives, including the efficient utilization and conservation of the Nation's resources."

Sections 40-106, 109, 111, 112 and 136, Idaho Code, provide that the improvement of highways is the established and permanent policy of the State of Idaho.

The Idaho Transportation Board allocates funds for highway improvement projects to mitigate impacts on sections of the highway network that no longer conform to the Division's goals and objectives. The commitments of funds, however, are make on a long-range basis, and changes to accomodate immediate needs would result in lower maintenance safety and service levels in those areas where improvements are delayed. The vehicular traffic count and highway sufficiency rating programs are maintained by the Idaho Division of Highways, and they form a portion of the data base used by the Board to establish priorities for highway improvement projects. The Division's road maintenance program will also mitigate some of the impact on the highway network.

Partial mitigation of the impact can be achieved by institution of staggered work shifts at the minesites and processing plants. The creation of a mass transit system for transporting mining and processing-plant personnel would lessen the impacts on the highway system and disperse impacts on the communities.

The bus system serving the ERDA (Energy Research and Development Administration) facility typifies this concept. Daily bus service between the Pocatello area on the south, the Arco area on the west and the Rexburg area on the east and the site transports about ninty percent of the employees to work (this figure fluctuates depending on the season of the year). Variations in work shifts and work locations at the facility complicates scheduling and a large fleet of buses are consequently required. The system is subsidized by the government; the employee pays 25 cents of the $1.75 one way trip fare.

SICOG (Southeast Idaho Council of Governments) has applied for Federal Highway Administration funding from the U. S. Department of Transportation to create a "full service" Regional Connector System for Southeastern Idaho. The initial proposal requested $837,143 to purchase five-60 passenger buses, three 16-21 passenger buses, radio dispatch equipment, wheel chair lifts, loading shelters, corridor parking facilities, and funding for slightly more than one-third of the first year operation and maintenance costs. In addition, 20,000 dollars would be used by SICOG personnel to conduct a two year monitoring and evaluation program to determine the best location and design of bus shelters, to make any necessary modifications in routes or bus scheduling to maximize use, and to insure that the system achieves its objectives.

Five routes would be created (Idaho Falls-Blackfoot-Pocatello, Malad-Pocatello, American Falls-Pocatello-Soda Springs, Pocatello-Soda Springs, and Preston-Soda Springs) to transport workers and students between the various communities in Southeastern Idaho. This system would require subsidization to generate user support and represent a cost effective alternative to private transportation. The user would be charged a 25 cent round trip fare, and the business or institution generating the passenger on the bus system would pay $1.25. SICOG received general support of the regional collector system concept at public hearings held on April 28, 1976.

Due to lack of available funding, SICOG reduced the original request from $837,143 to $470,100 by eliminating the three 16-21 passenger buses, loading shelters and corridor parking facilities. Bus size would be 45 instead of 60 passenger capacity (one additional bus would be purchased, however). The user would be charged an increased fare based on the amount of use the system receives. This would range from $0.95 to $1.15 per round trip. An additional route would be created that would run from St. Charles, through Montpelier to Soda Springs and return.

The U. S. Department of Transportation is presently reviewing the proposal.

Union Pacific Railroad operates under the authority of the Interstate Commerce Commission. Conformance with the applicable rules and regulations of the Interstate Commerce Act (49 Stat. 543, 49 U.S.C.) will mitigate the impact on the regional railroad network to some degree. A partial mitigation of the impact on the regional railroad system could be achieved if mining operations were modified to facilitate yeararound ore haul by construction of benefication plants at all minesites or complexes; such actions, however, are not deemed feasible.

Mitigation of the impact on the regional power transmission network will require the construction of additional transmission lines into the region and will necessitate the development of additional generating capacity. This additional capacity would possibly be supplied by expansion of the generating stations located in southwestern Wyoming and Utah. Some mitigation of the impact on the regional power network is possible through onsite power generation, but this would be minor.

4. RECREATION RESOURCES

In addition to those laws and regulations discussed in Section A, the following laws and regulations apply specifically to outdoor recreation:

1. Public Law 88-29 of May 28, 1963, authorizes the Bureau of Outdoor Recreation to develop a nationwide outdoor recreation plan to provide a policy framework in which Federal outdoor recreation-related programs will be developed and managed.

2. Public Law 88-578, the Land and Water Conservation Fund Act of 1965, as amended, provides for Federal monies matched by State or local money, on a 50-50 basis for acquisition and development of outdoor recreation areas and facilities.

3. Public Law 91-485, the Federal Surplus Lands for Parks and Recreation Act of October 22, 1970, provides for the transfer of surplus Federal lands and waters to States and their political subdivisions for park and recreation purposes.

Additional measures to further mitigate adverse impacts on recreation resources will be required as may be appropriate on a case-by-case basis. Such measures should begin in the planning stages and follow through until all extraction and mining operations have been completed in order to protect, restore, and preserve outdoor recreation resources. These could include the following:

Utility corridors, railroad tracks, access facilities, and roads not in harmony with and beneficial to outdoor recreation should be closed, and disturbed areas should be rehabilitated upon completion of mining operations.

Lease holders, permit holders and mining and development companies shall be responsible for implimenting mitigating measures. Mitigating measures in relation to recreation resources shall be interpreted as meaning restoring, protecting, enhancing and/or developing recreation opportunities in harmony with natural land values and the management and use plans of the responsible surface management agencies.

The influx of additional people from phosphate mining and processing operations, increased demands on outdoor recreation resources, and changes in the area's landscape with related adverse affects on recreation resources will call for strict regulatory measures for mitigation of cumulative effects on wildlife and aesthetics to maintain quality outdoor recreation. Since driving for pleasure is the most popular outdoor recreation activity, serious consideration must be given to the aesthetics and aesthetic quality. In order to mitigate adverse impacts to the visual qualtiy of the region, the Forest Service Visual Management System and the BLM Visual Resource Management System should be used as a guide in restoring and preserving the aesthetics.

The Oregon and Lander Trails shall be protected and opportunities for their adequate interpretive development preserved.

Access to public lands shall be maintained at all times. Rights-of-ways should be acquired by the appropriate Federal agency to insure public access.to public lands.

In addition to the above mitigation the Idaho Department of Parks and Recreation recommends that further study to analyse the capability of each impacted area to attract and sustain specific recreation uses be done. Contract work should be financed to provide information upon which to develop specific stipulations for all future mining operations.

Control of visible emissions from all processimg plants must be strictly enforced to conform to all state and Federal regulations.

The quality of all streams, lakes and reservoirs in the region will be protected by adequate stipulations requiring waterbars, sediment ponds, adequate revegetation and protection of existing riparian vegetation, and any other actions necessary to prevent runoff of silt and other sediments into such water bodies.

5. ARCHEOLOGIC AND HISTORIC VALUES

It is the stated policy of the Federal Government to preserve important historic, archeologic, and natural aspects of the Nation's heritage. This policy is indicated with the following Congressional Acts and Executive Orders:

1. The Antiquities Act of 1906 (34 Stat. 225)
2. The Historic Sites Act of 1935 (49 Stat. 666)
3. The Reservoir Salvage Act of 1960 (74 Stat. 220), as amended (88 Stat. 174)
4. The National Historic Preservation Act of 1966 (80 Stat. 915)
5. Executive Order 11593 "Protection and Enhancement of the Cultural Environment" May 13, 1971 (36 F.R. 8921)

In addition to the above-stated Federal laws and those listed in section A, further professional investigations and salvage operations are essential in order to mitigate adverse impacts on these resources that could be caused by the proposed phosphate mining. The following measures have been recommended by the State Historic Preservation Officer and the State Archeologist:

1. Consultation with the State Historic Preservation Officer and the State Archeologist to identify which cultural resources are or may be eligible for nomination to the National Register of Historic Places.

2. Nomination of identified cultural resources to the National Register of Historic Places.

3. Participation in a survey inventory of all areas under investigation. Inventory would include all areas where railroads, conveyors and haul roads would be built, as well as the mines, waste dump sites, and process plants.

4. Completion of a regional study of the southeast Idaho area for all cultural resources adversely impacted by the proposed phosphate mining. Such study would include interviews with longtime residents of the area to gather historic information.

5. Test excavations at selected sites found during the survey inventory to assess scientific values and to obtain stratified deposits. Areas directly impacted by the phosphate mining should be given first priority.

6. Detailed study and interpretation of the petroglyphs located in the area should be completed before increased population causes the destruction of these valuable aboriginal landmarks.

To meet responsibilities under the applicable laws. regulations and Executive orders pertaining to cultural resources, the approving Federal agencies will insure that mining plans, new leases and permits include a program for inventory, evaluation, and designation of appropriate mitigation of cultural resources, including sites, districts, buildings, and objects, on the Federal lease and permit areas. The cultural resource program will be developed in cooperation and consultation with the State Historic Preservation Officer (SHPO), as may be appropriate. Avoidance of cultural resources will be given priority over mitigation of impacts. If avoidance cannot be achieved, then prior to their injury or destruction, all impacts upon cultural resources shall be mitigated at a level commensurate with their significance.

No mining plans, permits, or rights-of-way will be approved until an acceptable cultural resource clearance inventory has been completed or stipulations and/or restrictions providing for the protection of cultural resources have been developed, and approved by the surface-administrating agency, and included as a condition of the approved mining plan or permit. The cultural resource stipulations and/or restrictions will be developed in consultation with the SHPO as appropriate; the responsibility for the final approval of cultural resource stipulations and/or restrictions will be that of the surface-administrating agency.

Prior to approval of mining plans or use-permits, the lessee or operator shall engage a qualified professional archaeologist to conduct an intensive cultural resource inventory for all evidence of cultural resources within the areas to be disturbed; and submit an acceptable report of the cultural resource inventory with recommendations for avoidance and/or mitigation it required; and, undertake such measures as deemed necessary by surface-administrating agency to mitigate any unavoidable effects of a proposed operation upon significant cultural resource values and the information they contain.

In the event of discoveries of cultural resources as the result of approved mining operations, the lessee shall notify the surface-administrating agency, and the Area Mining Supervisor, USGS. Appropriate mitigation will be undertaken as required. Prior to proceeding with any operations that might be destructive to a significant cultural resource discovery.

Many of the previously proposed measures will naturally reduce visual impact of the proposed mining, and ore processing and transporting operations. In addition, mounds and artificial landforms created for screening, access controls, or mitigation purposes shall be compatible with the scale, variety, and topographic character of the adjacent landscape.

Plant densities, combinations, placement composition, seasonal colors, scale, and aspect location shall give the site a natural appearance and reflect adjacent land characteristics. The original topsoil, when available, will be part of the seed source.

Insofar as possible, all haul roads shall be developed considering recreation opportunities and other resource needs upon completion of the phosphate mining. Such factors as vista potentials, interest, focalization, seasonal use, alinement, and scenic quality shall be considered. Borrow areas and staging areas should be screened from view and/or removed from main access and ore haul routes. Temporary roads used for prospecting, utility development, mine development, and other short-term uses shall be obliterated, and the land should be returned to the natural contour and satisfactorily revegetated. Service roads shall not parallel railroad tracks, conveyors, and utility routes in areas requiring major excavation, topography alteration, and timber removal; they should be located along less disturbed routes.

Increased access and a growing population will cause conflicts with the existing remote, undeveloped character of a large portion of the landscape. Because of this, the various phases of the phosphate development should be subject to close scrutiny. Buildings, structures, staging areas, employee conveniences, equipment, utility systems, signing, access control devices, and other physical factors of the development should cause as little visual deterioration as possible. Where permits are required BLM may require aesthetic evaluation, based upon visual simulation or comparable techniques.

So that adjustments may be made to minimize visual impacts, before approving mining-related operations and facilities in areas where

visual impacts will be high, the administering agency will require specific onsite evaluations of visual resources using the agency's then-current evaluation procedure.

CHAPTER V
ADVERSE EFFECTS THAT CANNOT BE AVOIDED

Based upon mining plans as proposed, a total of 6,700 acres will be disturbed on the leaseholds by the year 2000. Based upon production rates indicated by the companies and reclamation measures as proposed in Chapter IV, about 100 acres of land would be disturbed for each 1 million tons of ore mined annually. Progressive land disturbance would increase to about 2,100 acres by the mid-1980's and then stabilize at slightly over 2,200 acres. At a more probable level of mining of 15 million tons by the year 2000, there would be a progressive disturbance increasing from about 400 acres in 1975 to 1,500 acres in the year 2000.

A. NATURAL ENVIRONMENT

1. LAND RESOURCES

a. Land Surface

Based upon mining plans as orignally submitted, changes in the land surface due to the creation of 2900 acres of pits and 3000 acres of dumps are unavoidable, although the magnitude will be lessened where partial backfilling is planned.

Unavoidable slumping of waste piles could result from strong earthquakes.

The net disturbance of the land surface is shown in figure 1-37 . The cumulative disturbed area is based upon the proposed sequence of mining for the mining plans considered in this statement. The cumulative reclaimed area is based upon reclamation of disturbed land and dumps in the season following disturbance. Actual disturbed, unreclaimed land on the mining sites will increase to about 2,100 acres by the mid-1980's and then stabilize at slightly over 2,200 acres for the next ten years. About 2,240 acres will remain unreclaimed largely in the form of pits, at the year 2000.

Based upon a more probable level of mining as shown in table 1-1a, there will be 1597 acres of pits, 1770 acres of dumps. About 790 acres will be disturbed for offset transportation and utility facilities. The rate of disturbance is shown in figure 1-37b. In addition, the proposed beneficiation in Diamond Creek will require 112 acres rather than 840 acres, and the proposed plant in Dry Valley would not be built.

b. Geology and Mineral Resources

At both levels of mining, prime phosphate resources will be removed, as will resources of other constituents in the phosphate rock: fluorine, vanadium, uranium, and rare earths. At the Paris-Bloomington minesite, where phosphate and vanadiferous zones will be mined, still other lost resources will include selenium, zinc, silver, thallium, and cadmium.

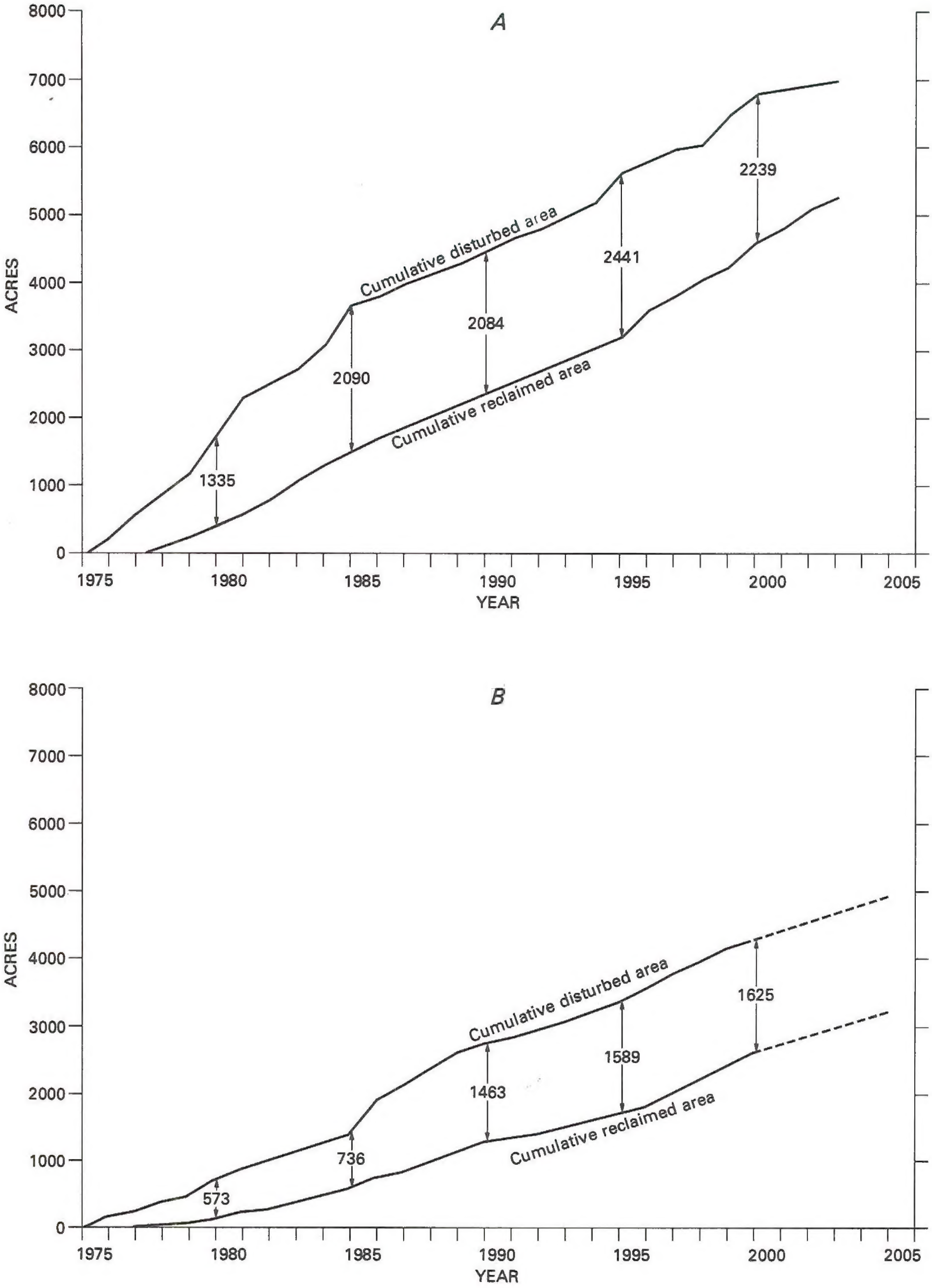


Figure 1–37.—Total land disturbance and reclamation from proposed mining, 1975–2000. *A*, Based on mining plans as submitted for approval. *B*, Based on revised level of mining. The distance between the two lines is the average disturbed in any given year. Paris-Bloomington impact insignificant. Swan Lake Gulch all after year 2000.

Partial backfilling of some pits with waste rock would adversely affect the possible future recovery of additional ore-grade phosphate resources that extend downdip from the bottom of the pits.

c. Soil

Based upon mining plans as originally submitted, soil will be removed or altered on about 5900 acres by pits and dumps. Ultimate loss of soil cover on about 2,240 acres of remaining pits cannot be avoided. Topsoil stockpiled for reclamation will be sufficient for surfacing only a limited amount of disturbed areas. In those areas not resurfaced with topsoil, soil development will have to start again, forming new soils with characteristics unlike the present ones.

An additional 1,340 acres of soils will be disturbed by transportation systems, service facilities, and water-handling structures. These areas will experience unavoidable loss of productivity during use, and some lesser loss after rehabilitation.

Reduced soil productivity, permeability, and infiltration rates of the disturbed soils are unavoidable. Increased erosion and sedimentation rates will occur, but the amount of activity-related soil loss through time cannot be determined from available data.

Based upon a more probable level of mining, as shown in table 1-1a, a total of 4,159 acres of soil will be disturbed, of which 2,634 acres will be reclaimed.

2. WATER RESOURCES

a. Water Supply

1. Surface Water

At either rate of mining, mitigating measures would not prevent all impacts to the surface water resources. On the basis of experience at existing mines and of available data, severe impacts could result from some mines, minor impact could result from others, and little or no impact could result from still others. Potential for unavoidable impacts appear high for Stewart Canyon, Diamond Creek, Swan Lake Gulch, South Maybe Canyon, Dry Valley Creek, Trail Creek, Slug Creek, Soda Creek, Portneuf River and Blackfoot River; moderate for Middle Sulphur Canyon, Little Blackfoot River, Angus Creek, Bloomington Creek, and Paris Creek; and minor on Bear River. Specific details are given in Parts 4 through 11.

Lowered infiltration rates of snowmelt and precipitation will continue after revegetation and other reclamation measures are implemented. Surface flows, both peaks and volumes, from the disturbed areas will be greater than they are now. Existing drainage patterns and surface-flow characteristics would be altered. Base flows would decrease, and flows during snowmelt would increase.

Concurrent with increased surface runoff, the potential for increased sediment movement would continue for a long time after mining begins. Increased flows would probably cause the scouring of channels to accommodate the increases. Buffer zones, filtration strips, French drains, and sedimentation ponds would tend to fill with silt and become less effective during high flows as retention times decreased. Water-diversion structures and control devices--French drains, spillways of retention ponds, culverts, and other structures--could be inadequate during floods. Emergency flood-control measures are usually ineffective in controlling impacts such as sediment movement into receiving waters. Some proposed activities may cause massive earth movements, which could pollute some of the channels for long periods of time. Accidents could occur. Other events, such as the plugging of channels with trees or other debris, could cause excessive scouring and sediment movement. Only a few plans specify lining of interceptor ditches or provide for gutters or conveyors to avoid erosion. Some erosion would undoubtedly occur in new or in unlined channels.

Because recharge through the compacted dump material would be very slow, the runoff would probably exceed the percolation rate. At these sites, unless alternative methods are used to dispose of excessive runoff, damaging flows over the dumps or pits could occur. Most plans are not sufficiently detailed to indicate the amount of flood discharge or volumes of flow that the planned structures will accommodate. One plan provides for an estimated discharge based on a 20-year rainfall. This estimate may be considerably less in rate or volume than the maximum flood or volume which occurs during an annual snowmelt season. Thus, hydraulic structures may be underdesigned. There is little evidence that engineering design or analysis has been applied to the location and site slopes of the waste dumps and to an assessment of the competence of the slopes on which the dumps would be placed. In Chapter II, land-type associations 7, 8, 9, 10, and 13 are reported to have a high or very high potential for slumping, and placement of dumps on them may contribute to massive slope failures, especially where failures already have occurred on undisturbed slopes. Erosion potential is likewise high on some land-type associations. Water-control devices and dumps could cause serious pollution problems on these areas if the proposals are implemented. Quantification of the effects that cannot be avoided depends on whether the designs could or would be modified under the regulations of the controlling agencies.

2. Ground Water

Increasing use of ground water as proposed will lower water well levels and discharge of ground water to streamflow. Reduction in base flows at places in the study area would be adverse, but probably of little significance.

The adverse impact resulting from the interruption of aquifers during mining cannot be avoided. The extent of the area that will be influenced by this disruption around the mined area will vary depending on various aquifer properties, but will be of only local significance.

Development of lakes, ponds, and pits of water at the completion of mining cannot be avoided under present economics in some areas. This will be adverse to the extent that it depletes streamflows and adds to evaporation loss of water which then is not available for other uses (agriculture, stream fishing habitat).

Some reduction in ground-water quality resulting from leaching of toxic wastes, accidental spills, and escape of toxic materials from ponds will probably occur, but quantitative amounts cannot be determined with present data.

b. Water Quality

At either level of mining, some reduction in water quality will result, but many of the deleterious materials will be largely mitigated by natural factors and legal requirements as discussed in Chapters II and IV.

Increased turbidity and sediment loads in some streams is unavoidable. Toxic elements, including arsenic, cadmium, molybdenum, selenium, vanadium, and zinc may increase, but their surface-water concentrations may in general be maintained at levels that will not be harmful for domestic and other uses by natural factors. However, a few data exist that indicate that near processing plants arsenic in well water sometimes exceeds the EPA iterim drinking water standard and for two stream samples mercury exceeds the EPA recommendation for freshwater aquatic habitat. These elements among others are relatively enriched in rocks of the Phosphoria. Radioactivity levels in water, resulting from the traces of radium and uranium in the Phosphoria, may increase somewhat, but dangerous levels will be mitigated by natural measures such as absorption and decay. The nutrients phosphorus and nitrogen may increase in surface water, causing slimes and nuisance algal blooms.

However, nutrient concentrations in ground water are not mitigated by existing laws and may increase to high levels in the vicinity of certain industrial operations. For example, wells sampled at and near Conda in March 1975, showed the following concentrations of nitrate plus nitrite (as NO_3) and orthophosphate (as PO_4):

WELL	LATITUDE	LONGITUDE	NO_3	PO_4
J. R. Simplot No. 8	42°44'02"	111°32'38"	36	71
J. R. Simplot No. 10	42°43'44"	111°33'08"	41	46
Torgenson Well	42°44'27"	111°33'47"	62	.21

According to EPA standards, concentrations of nitrate (as NO_3) above about 44 ppm should not be used for infant feeding, but for other uses the levels of NO_3 and PO_4 are not particularly harmful. They are, however, indicators of ground-water contamination.

Another element whose increased concentration will not be mitigated is boron; however, little data are available on the concentration of that element in the area although it does exist in the Phosphoria.

Release of toxic elements from the industrial ponds into the ground water will be averted by monitoring and enforcement of existing statutes. Although natural factors have the potential to mitigate inadvertant releases, the sorptive capacity of the soils and aquifer materials have an unknown but finite capacity for adsorption and absorption. Reliance solely on natural factors should be discouraged by regulatory agencies.

c. Water Use

At either level of mining, the increased use and consumption of ground water for mining and processing of phosphate rock, and attendant peripheral uses, cannot be avoided. The estimated maximum annual use of water, based upon mining plans as originally submitted, is about 88,000 acre-feet; at the lower, more probable rate, it is 22,500 acre-feet. If slurry transport of ore is adapted, the use will be somewhat greater. How much of this additional use will be from ground-water source is indeterminable at present.

The amount of water identified as being needed for phosphate purposes could, if all developed from the Bear River drainage, constitute a significant portion of Idaho's entitlement under recently proposed Bear River compact amendments.

3. AIR RESOURCES

At either level of mining, some lowering of air quality cannot be avoided. Mining will introduce minor amounts of dust and vehicular emissions; the effects will likely be local. Watering of use areas will minimize the magnitude of the impact.

Air quality will be lowered in the vicinity of the proposed new beneficiating plants. Amounts of emissions will be controlled by Federal and State laws and regulations. Although emissions will vary somewhat from plant to plant, characteristic emissions will be similar to those of the proposed plant near the Diamond Creek mine (See Part 4.1).

Unless air quality laws and regulations are strictly enforced, air quality will further deteriorate as a result of proposed increased production at either level of mining, but especially at the higher level. Increases, based upon present operating conditions, are described in Chapter III. The impacts will be felt predominately within a five-mile radius of the plants. Strict enforcement of all Federal and State laws and regulations will still result in some lowering of air quality, largely in the vicinity of the processing plants.

4. VEGETATION

The success of revegetation efforts will not only vary from mine to mine, but also at different sites at any given mine. Success depends on the unique natural physical factors at each location and on the extent of alteration of the natural topography. No sites, however, are expected to be so altered as to preclude rehabilitation, with the possible exception of the steep pit walls and other exposed rock surfaces; however, the land occupied by railroads, roads, processing plants, and other facilities, cannot be revegetated and will remain nonproductive as long as the facilities exists.

Although the mining pits could be backfilled to the original ground level, the change in the physical properties and constituents of the soil would probably require replacing at least some of the native plant species with introduced species.. Native vegetation would be reestablished wherever possible, but nonnative species, particularly grasses and legumes, would probably have to be extensively used. Maintenance of these new communities might require extensive fertilizer applications, but even then the productivity of the rehabilitated sites would probably never equal that of the natural, undisturbed communties.

Timber productivity on mined sites will be unavoidably reduced because the disturbed sites cannot support timber cover for many years. Mining activities will change the water flows that determine the composition of vegetation communities, causing more drought-tolerant communities to develop on some sites; more water-tolerant communities on others.

The two major pollutants produced by ore-processing plants, fluorides and sulfur dioxide, probably would be mitigated to the extent that emissions would be held within established standards. However, even though emissions might be small and dispersed, they might have cumulative effects on the local vegetation. Fluorides in concentrations as low as 0.1 ppb (parts per billion) have injured plants in localized areas; they accumulate in the plant and eventually kill the leaf tissue. Alfalfa, a more common plant in the study area requires, a 120 day exposure to 1 ppb before markings occur. No area crops have been affected by flourides. Fluorides can also be transferred from plants to herbivores, causing fluorosis, a disease of the bone. Continual small emissions of sulfur dioxide may cause long-term effects on forest-timber growth but quantitative data on the cause-and-effect relationship attributable to the phosphate industry are not available.

5. WILDLIFE

Based upon mining plans as originally submitted, important wildlife habitat will be unavoidably reduced because of the proposed mining activities, and wildlife resources will be unavoidably disrupted during the mining activities. As much as 20,000 acres of elk habitat will be affected, with about 7,000 directly altered by mining and the rest affected by increased human activity.

The proposed mining will disrupt the natural traditional movements of elk, deer, and moose. The increased traffic, fences, cuts and fill locations and increased human activity will disrupt the movements and behavior of big game in Herd Units 76, 66, 66A, 69 and 78. The year-round habits of moose in the study area will be affected. The loss of traditional elk calving areas and numerous wallows in the study area cannot be avoided and use areas for an estimated 350 elk will be altered or lost over a 25-year period. About 6,880 acres of deer range also will be altered or removed, displacing between 1,640 to 2,260 deer by the year 2000. Approximately 5,000 acres will be reclaimed, providing some of range benefits. Approximately 1,000 additional deer will be displaced due to alteration loss of other use areas. Black bear and mountain lion will be unavoidably affected by the increased human activity associated with the proposed mining activities.

The proposed mining activities in Slug Creek, Dry Valley and Rasmussen Valley will alter 3 sage grouse strutting grounds. Human disturbance in 4 known nesting areas cannot be avoided resulting in loss of use of these areas. The alteration of 10 brood rearing habitats, 7 winter ranges, along with human disturbances, road kills and increased poaching will result in lower recruitment each year of as many as 660 grouse into existing populations and cannot be avoided. Alteration of as much as 3,500 acres of suitable breeding, nesting and brood rearing habitat for forest grouse cannot be avoided. The loss of habitat for blue and ruffed grouse and increased mortality resulting from road and railroad kills cannot be avoided. An estimated 1,840 forest grouse could be lost annually by the year 2000.

About 7,300 acres of small game habitat will be altered over the 25-year period. About 5,000 acres will be reclaimed, providing some recovery of habitat. Cottontail and pygmy rabbit populations will be unavoidably reduced by loss of habitat and increased road kills, as will present jackrabbit and snowshoe rabbit populations.

Five areas of high density or excellent mourning dove habitat and 7 areas of moderate density or good habitat will be unavoidably altered. Disturbance to duck nesting and feeding areas cannot be avoided. Mallards, pintail and teal will be principally affected. The proposed mining activities in the Diamond Creek, Blackfoot River, Slug Creek, and Soda Springs to Blackfoot River Road areas will unavoidably disrupt the nesting, brood rearing and feeding areas of the Canada geese and other waterfowl.

All or part of excellent and good beaver and muskrat habitat will be unavoidably modified in the Slug Creek, Diamond Creek, Johnson Creek, Blackfoot River, Rasmussen Valley and Georgetown Canyon areas. Human activity and disturbance from mining and from general population growth will affect bobcat, Canada lynx, pine marten, and others, as habitats adjacent to and within the mining areas are altered. Resident populations of ground squirrel, chipmunk, badger, shrew, porcupine, pocket gopher and red squirrel will be unavoidably disrupted by the mining and transportation activities.

Twenty-seven raptorial species will be unavoidably impacted by the mining activities through human disturbance and loss of nesting and feeding habitat. Total abandonment of some mining sites and corridors will result for the majority of the raptors. Nesting and brood rearing habitat for sandhill cranes and whooping cranes will be affected in the Diamond Creek, Slug Creek, Dry Valley, Enoch Valley, Rasmussen Valley and Blackfoot River Corridors. The loss of habitat resulting from human disturbance to these birds cannot be avoided.

The reduction of nesting and feeding habitat for a variety of song and insectivorous birds, with resultant reductions in numbers, cannot be avoided. Loss of habitat will also reduce populations of amphibians and reptiles in the area.

Mining and associated activities in the area will have unavoidable impacts on two endangered species, the whooping cranes and the peregrine falcons. The loss of riparian habitat along Diamond Creek, Lanes Creek, Slug Creek, Dry Valley areas will reduce the possible future nesting and brood rearing habitat for expanding the recently introduced whooping cranes. Feeding grounds for the peregrine falcon in the northern part of the general mining area could be reduced.

Based upon a more probable level of mining, as shown in table 1-1a, unavoidable impacts will be significantly reduced. About 12,500 acres of habitat instead of 20,000 acres will be affected.

About 200 elk will be impacted instead of the estimated 375 at the originally-proposed mining levels, about 2,300 deer instead of 3,000 deer, and perhaps about 5 fewer moose. Impacts to waterfowl will be reduced about 60 percent. Impacts to sage grouse will be reduced about 50 percent, and about 1,500 instead of 1,840 forest grouse will be affected. Only 5 instead of 10 areas of good mourning dove habitat will be impacted. The projected impacts on the sandhill cranes would be lessened in the Woodall Marsh, Slug Creek, and Swan Lake areas.

Based upon a more probable level of mining as shown in table 1-1a, impacts will not occur at the Husky No. 1 minesite and along the 25 miles of railroad originally proposed. However, according to the Idaho Fish and Game Department, there will only be minor reductions in the impacts to wildlife from the mining activity. The Task Force believes that, because of the significant reduction of population associated with the lower level of mining, and the significantly lower overall population projections for the region, the total impacts as previously determined will be moderately to significantly lower.

6. FISHERIES

At either level of mining, streams will receive increased sediment from disturbed areas, causing channel modification and increased turbidity. Transportation systems will encroach on segments of streams, altering channels and degrading the aquatic environment. Certain stream segments, such as in Stewart Creek, will be completely eliminated, covered by waste dumps, channelized, or routed through pipes. Stream flows will be altered from natural states, as in Diamond Creek, Angus Creek, and Dry Valley.

Streams will receive mine-influenced water of lower than natural quality. The total quality of the aquatic environment will decrease, and the composition of fish faunas and size of fish standing crops will be degraded accordingly; these faunas will become dominated by undesirable species. Stream temperatures could increase because of removal of vegetation. Beaver dams will undergo accelerated filling by the increased sediment.

B. CULTURAL ENVIRONMENT

1. LAND USE

a. Land Ownership

Based upon mining plans as originally submitted, the commitment of land for the proposed new processing plants and for expansion of existing plants cannot be avoided; about 3,000 to 3,500 acres will likely be required for four new beneficiating plants, and an undetermined but lesser acreage for expansion of existing plants. It is likely that most of the expansion of existing plants will take place on lands already owned by the companies. Most of the land for new plants will likely be undeveloped rangeland.

Based upon a more probable level of mining, as shown in table 1-1a, unavoidable changes in land use would be drastically reduced. Conversion of about 2700 acres for the IMC and FMC beneficiating plants will not occur. The requirements for about 2400 acres for the Alumet beneficiating plant has been reduced to about 250 acres for the plantsite.

Conversion of land to residential use will also be substantially reduced because of reduced population projections, both for overall populations and for that specifically associated with the phosphate industry.

b. Agriculture and Range

About 7,200 acres of vegetation will be removed from the minesites over a 25-year period, but 5,000 acres will be reclaimed. The total livestock use lost during this period depends on rehabilitation and revegetation successes. Undoubtedly, livestock use will decrease from the existing level because of the reduced amount of vegetation that will be reestablished. The 1,650 acres of mining-pit areas not backfilled will be lost permanently. Assuming an average carrying capacity of 10 acres per animal month of feed over a 25-year period, about 4,100 animal unit months of feed would be lost from these areas. Recovery of the livestock forage lost will depend on revegetation successes and the type of vegetation used.

During ongoing mining operations, livestock will have to be kept off the areas either for safety or because of lack of vegetation. Usual livestock movement will be impaired and the existing utilization patterns will undoubtedly change. Livestock operators and/or surface managing agencies will have to increase forage production in other areas to take care of existing livestock or the numbers will have to be reduced accordingly. Some of those unable to change their operations may be forced to sell out. The new livestock patterns could also impact on wildlife and aesthetics.

Redistribution of water will also impact on livestock. Usual trailing patterns to and from water will be changed. An unavoidable impact might be the change in water quantity and quality caused by distrubances to watersheds.

From 40 to 60 acres of dry-land crops will be unavoidably lost.

Based upon a more probable level of mining, as shown in table 1-1a, unavoidable impacts to agriculture and range will be significantly less. Land subject to total or partial loss of forage directly from mining will be reduced from 8,900 acres to 4,159 acres. Approximately 5,100 acres required for new beneficiation plants will not be required. Significant lowering of projected population increases, both overall and specifically associated with the phosphate industry will siginficantly lessen the amount of land required for conversion to residential acres. With little or no expansion of processing, except for Beker, increases in fluoride emissions should be minimal, if any.

2. SOCIOECONOMIC DEVELOPMENT

At either level of mining, the increases in population caused by the proposed action will result in significant changes in the cultural environment. Newcomers can be expected to bring with them expectations and interests that are different from the resident population. Some social differences will be modified as the incoming population mixes with established residents, but others may contribute to long-term divisions unless some efforts are made to achieve social integration. This is especially so in Bear Lake and Caribou counties where habits and even the appearance of new residents may not conform to existing customs. There appears to be no way to mitigate this type of impact.

Changes in population will affect the cultural environment in three ways that will be considered adverse by some persons, but the impact will be differential within the general population. First, resource disturbances and changes in landscape characteristics at mining and processing sites will be regarded as undesirable by some residents. Individuals who prefer that the area remain in its original state will be adversely affected. Second, the subtle changes attendant with population growth will expand urban areas, utilize all facilities and services and be regarded adversely by individuals who feel that increased population, by itself, creates a sense of overcrowding and competition for increasingly scarce natural and primitive resources. Third, new residents may alter traditional bases of political power in Bear Lake and Caribou counties. Current office holders may find it necessary to adjust policies to reflect new attitudes, expectations and desires of new residents. Some changes in political power bases and institutions may be expected in these counties. Impacts of this type are not likely to have as great an impact upon Bannock County where growth due to the proposed phosphate development will occur on a much broader population base and where current interests are currently more diversified than in the two smaller counties. There is no way that such impacts can be avoided. And it is not evident that such impacts would be regarded as undesirable by all present residents.

The price levels of land and housing can be expected to increase. Rents will rise and the prices of new homes will reflect higher land, material and labor costs. The real purchasing power of some residents will be increased because they will receive more than proportionate increases in income relative to price changes. Other residents, especially those living on relatively fixed income may suffer a loss in real income. This would particularly affect the retired and disabled. Those living in rental housing will especially notice this change because an increase in rental housing will be one of the first and most significant impacts experienced as the development begins. In some highly impacted communities individuals with low incomes have been expulsed so that housing units could be rented to individuals with greater purchasing power. The Farm Home Administration and the Department of Housing and Urban Development administer programs in the study area that are designed to provide low income housing and/or rent supplements. The size of these programs in the study area is so small that they do not provide at present levels anything more than token efforts in behalf of families and individuals with modest incomes. There appears to be no obvious way to mitigate this impact.

The areas's crime rate and other measures of social pathology (such as alcoholism and drug abuse) can be expected to increase, especially during the construction phase. These problems have increased generally in other regions with population growth and especially where "boom" scale economic development has occurred. These tendencies will be more noticeable in Bear Lake and Caribou counties since social changes concurrent with growth have either already occurred to a greater degree in Bannock County or will be more the result of exogeneous impacts not associated with the proposed phosphate development. Although the problem of increased rates in what might be generally described as social pathology can't be totally overcome, adequate planning by local, State and Federal officials to provide increased law enforcement staff and rehabilitative facilities, family counseling services and adequate mental health programs would tend to abate impacts in this area.

3. TRANSPORTATION AND UTILITIES SYSTEMS

At either level of mining, increased traffic on the regional highway network cannot be avoided. This increase will begin in 1976-77 and peak in the mid 1980's. Based on available information, associated traffic volumes should remain constant after the mid 1980's. In addition, highway improvement costs and increased maintenance costs cannot be avoided. Since highway improvement projects generally lag behind the need, unavoidable adverse impacts on highway users will be reflected by travel delays, greater vehicle operating costs and deterioration of travel comfort and convenience. Another unavoidable adverse effect will be an increase in the number of automobile accidents and related costs.

Increased traffic on the regional railroad network also cannot be avoided. The adverse effects which cannot be avoided as a result would include an unquantifiable increase in the number of train/car accidents, increased noise, a deterioration in air quality, increased conflict with livestock and wildlife and greater potential for right-of-way fires.

Increased power consumption in the region cannot be avoided. The adverse effects of increased power use is contributed to the adverse effects on the environment caused by additional transmission line construction in the region. Construction of additional generating capabilities within the region is very small using only the phosphate industry growth as the facotr for site selection, and expansion of generating capability. This would likely include removal of vegetation, increased soil erosion, impairment of aesthetic values, impact on wildlife and fisheries, additional water use, air quality deterioration and depletion of coal reserves, none of which can be quantified at this time.

4. RECREATION RESOURCES

At either level of mining, outdoor recreation quality and opportunities in the southeastern Idaho phosphate region will be unavoidably affected. Loss of wildlife habitat and increased hunting pressures from an increased population will reduce the quality of hunting experiences. Changes in aquatic habitats and increased fishing pressure will also reduce the quality of fishing experiences.

Dust, odors and noise will be unavoidably introduced into the atmosphere, creating a deterioration of the area's aesthetic quality and reducing outdoor recreation resources for both active and passive activities.

Driving for pleasure is the region's most sought outdoor recreation activity. Numerous areas of natural beauty in the region with a variety of rivers, lakes, mountains and scenic vistas will be unavoidably reduced in aesthetic quality as a result of the proposed action.

Mining operations combined with related transportation and utility systems and man-made intrusions will unavoidably remove from the region a significant part of the remaining natural phenomena, and primitive and remoteness characteristics and thereby reduce a valuable outdoor recreation resource.

The proposal will increase the population of the region and therefore bring unavoidable increased demand pressures on existing outdoor recreation resources.

Drastic increased demands on a fragile-balanced ecology and environment will have unavoidable far-reaching adverse effects for a long-term to permanent duration on recreation resources unless adequate measures are established for mitigation of these impacts. In this region, the increases in population will have much more severe adverse impacts on the existing outdoor recreation resources than the proposed mining operations.

Based upon a more probable level of mining as shown in table 1-1a, there will be a significant reduction in impacts to the outdoor recreation opportunities. Elimination of the proposed railroad through the Blackfoot Narrows and in Dry Valley and Slug Creek will preserve many recreation resources that would be changed or lost through such development. The areas of the three proposed mines that will not be started until after 2000 A. D. will continue to be available for recreational uses until that time. Perhaps the biggest, but unquantifiable reduction in population forecasts for the area, both in overall population and for the phosphate industry itself.

5. ARCHEOLOGIC AND HISTORIC VALUES

At either level of mining, damage could result from mining activities even after competent premining inventory and investigation for historic and archaeologic materials and frequent spot checks during mining. This could include destruction of archaeological sites. The damage to these sites would be a permanent loss of educational and scientific interpretations.

Urban and suburban expansion could result in destruction of historic sites not listed in or nominated for the National Register of Historic Sites, but nonetheless historically valuable. Increased population with changing cultural values will unavoidably result in further modification of the remaining cultural and historic heritage of the area.

6. AESTHETIC VALUES

At either level of mining, increased mining, processing, and ore transporting activites will unavoidably conflict with the general remoteness of the area; resulting disturbances will stand out against the natural form, line, color, and texture of the landscape. Mining and many related activities, will not meet the visual quality objective that the visual-variety, sensitivity, and visual-resource quality suggests.

The aesthetic quality of the landscape will unavoidably be diminished by industrial haze and mechanical noise as a result of the mining and related activities. Siltation will diminish the aesthetic appeal of some streams. At some sites, vegetation surrounding ridge-top minesites will cause color contrasts with the mine which will be especially noticeable in the spring even at great distances.

Encroachment or elimination of habitat will reduce the chance of viewing fish and wildlife, thus reducing animation and the landscape's visual appeal.

New processing plants, such as the one proposed in Diamond Creek, will unavoidably dominate the landscape. Roads will be out of scale with the area's use capacities. More people will be able to leave the highways and enter the area, magnifying the landscape's visual sensitivity. Long, straight tangents required for haul roads, railroads, powerlines, and gas lines will be visible from primary use areas. Cuts, fills, and vegetation removal on such routes will be unavoidable discordant elements.

At the lower more probable level of mining, the severe visual impacts associated with the proposed railroad through the Blackfoot

Narrows and in Slug Creek and Dry Valley will not occur. High visual impacts from the proposed Husky No. 1 mine, and the low to moderate visual impacts of the Caldwell Canyon and the Blackfoot Bridge will not occur through the year 2000.

CHAPTER VI
SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY OF THE AREA

Phosphate has been mined in southeastern Idaho as early as 1907; it has been a significant on-going operation for more than 30 years. Because the western phosphate field contains almost half of the phosphate resources in the United States, it is likely that mining of phosphate will continue at some level of production well into the future. Based upon mining plans as submitted, about 365 million short tons of phosphate will be mined. This is about one-third of the known reserves in southeastern Idaho. Over a 25-year period to the year 2000, about 282 million short tons will be mined. It is likely, however, that mining will not proceed at the rate indicated by the 16 mining plans submitted to the Federal government for approval, but more likely at a probable level of production reaching 15 million tons annually by the year 2000 A.D.

The following discussions relate to mining at either level.

A. SOILS

In the short term, the natural soil will be changed, as will its ability to grow and support plant communities as they now exist. The time required to develop the existing soils is not known, but soil scientists estimate that they are several hundred to several thousand years old; the plant communities have evolved with the soils. Therefore, even with restoration of the soil, it is unlikely that it will be suitable for full recovery of the present native plant communities.

If overburden materials have slopes of 3:1 or less, and are reclaimed properly through replacement of the topsoil, some irrigation, and application of amendments, grasses, shrubs, and even trees can be established after reclamation. Pit areas, even with known reclamation measures, will be difficult to revegetate after mining. These areas will require much more time and more intensive reclamation measures to return to productive vegetation, if at all. With proper reclamation measures, soil productivity will gradually improve through natural processes in the long term.

B. WATER RESOURCES

The main short-term effect on the ground-water systems in the impacted areas will be lowered water levels due to ground-water drainage into the pits and pumpage of water for mining and processing operations. This effect in mining areas will last only during the life of most pits that will be backfilled. The effect of lowered water levels would be to diminish and possibly dry up spring and stream flow, to result in greater pumping lifts in nearby wells, and to remove moisture from the reach of some water-loving plants. Drainage of ground water into the pit area will stop in most pits, when the pit is backfilled or pumping from the pits and nearby areas ceases. Ground water levels around the pits probably will recover and stabilize at about pre-mining levels after backfilling.

Some perched ground-water bodies will be permanently drained by the pits; some, however, might refill with water when the pits are backfilled. Perched water bodies that are drained by road and railroad cuts probably will remain permanently drained.

Concurrent with increased surface runoff, the potential for increased sediment movement could continue for a long period after mining begins. Increased surface flows from the impermeable surfaces would probably scour channels in order to accommodate the increase. The trend would be for sediment to move progressively downstream as temporary sediment-retention devices, including buffer zones, filtration strips, brush barriers, and small sedimentation ponds, filled with the sediment eroded from the disturbed areas and as the retention times decreased. Interceptor ditches, berms, erosion-control gutter, culverts, drains, and other water-control devices often result in erosion unless the energy in the flows is carefully controlled. Data are insufficient to quantify accurately the regional effects. It is unlikely that all of the potentials for erosion would be controlled over the long term.

Reduction in ground-water recharge by roads, railroads, parking lots, waste dumps, and backfill will be long-term, but probably of little significance. If the paving on roads and parking lots is removed upon completion of activities and the land scarified, some of the recharge can be restored.

Most springs that are destroyed by pits, dumps and transportation systems will be lost permanently. In some places, the spring discharge may reappear upgradient from backfilled pits or as seeps from the toe of some waste-dump slopes where the dumps are underlain by permeable material such as alluvium in streambeds. Permanent seeps and boggy areas may form on the upgradient side of some backfilled pits.

Increased withdrawals of ground-water for expansion of processing plants will lower ground-water levels in the Conda-Soda Springs and Michaud Flats area. The maximum lowering will occur when the maximum withdrawals are made. When, and if, withdrawals are decreased or production diminishes, the water levels will recover. Long-term adverse changes in ground-water quality could occur in Soda Springs area if withdrawals in that area are greatly increased. Long-term changes in water quality could also occur from accidental escape and infiltration of highly contaminated water from gypsum, and some other settling ponds in the processing plant complex on Michaud Flats. However, it does not seem likely that ground water will be mined.

Some existing water uses may be interfered with, either directly through the diversion of water from stream channels or ground-water sources, or from interruption of recharge or runoff, or through changing the timing and occurrance of flows.

Despite firm controls, the quality of water will decline on a long-term basis because (1) increased pumping of ground water will cause water from different aquifers, having different salinities and chemical composition, to mix and thereby lower the quality of the one with the better characteristics, and (2) water of return flows from industrial use will be of lower quality owing to evaporation, hence increased chemical constituents, and to the alteration of the composition of dissolved solids by selective adsorption of some chemical components and the release of others.

The short- and long-term effects of undesirable constitutents such as certain toxic elements and radioactive nuclides are likely to be small in mining because of low solubility and adsorption. This will likely also apply to major chemical constituents.

However, processing operations, even that related to beneficiation (if water is involved in sizing, for example) may exert greater short- and long-term effects, at least with respect to nutrients. Existing conditions near the processing plants at Soda Springs-Conda and Pocatello suggest that natural constraints can be overpowered and ground water can contain very high concentrations of nitrate and, in some cases, phosphate; these effects will be long term.

Mobility of arsenic around processing plants is also suggested. This would probably be long term. Available data and theoretical considerations, for potentially toxic elements suggest that concentrations in solution are likely to be small but their distribution in sediments represent unknown but possible impacts that would have long term effects.

The quality of surface streams may also undergo deterioration due to chemical pollution from processing plants, either as surface discharge or as discharge from aquifers that have become polluted from the operations.

C. AIR RESOURCES

The lowering of air quality will be short term. Dust and vehicle emissions will affect air quality locally during mining operations. Emissions from new beneficiating plants located near minesites will further lower air quality on a short-term basis during the life of the plants. Further lowering of air quality in the vicinity of processing plants, though severe, will also be short term.

The cumulative effects of the proposed development and operation of mines, beneficiating and other plants, transportation networks, and the secondary effects of the influx of people and related activities would cause significant changes in air quality and in microclimates over the long term. Increases in dust, carbon monoxide, hydrocarbons, and particulates in the atmosphere for many years are unavoidable. Increases in smog and haze would probably occur. Modified regional weather over the long term may occur, but identification and quantification of these impacts on weather is not possible with available data. Unavoidable changes in land-surface characteristics on the disturbed areas will alter wind, snow, and dust-movement patterns, and the drifting and melting characteristics of the snow.

D. VEGETATION

Long-term productivity of the disturbed lands will be reduced about 50 percent from present levels even with successful revegetation. Additional reclamation techniques must be further tested before any final predictions of success ratios can be made. All plant succession is unavoidably destroyed at the time of disturbance. Fifty years or more of plant succession will be required for these areas to return to their present state because the existing soil structure and microclimate will have been changed. Some plant associations may not be able to reestablish themselves on the altered sites. Final reclamation of any given area will lag a couple of years behind mining; plant succession will be displaced for at least that period of time.

New and expanded production will adversely affect localized areas of vegetation. Quantities of emissions would be expected to increase with time as the industry develops, with both short-term and long-term effects on vegetation.

E. WILDLIFE AND FISHERIES

The impact to the wildlife as related to short-term use versus the long-term productivity would depend upon the time required to reestablish suitable environmental conditions. The ability and time required for the wildlife populations to adjust to learned patterns of behavior such as migration routes, wintering areas and reproduction areas is unknown. For most species this may be impossible to restore. Some of the more tolerant wildlife species should be reestablished as soon as required habitat conditions are provided. The species related to the early succession and seral plant communities will probably be restored as soon as the mining is terminated and the first stages of vegetative reclamation are begun. However, in order to restore suitable blue grouse wintering habitat in mined areas, a period of several hundred years would be required. It would take even longer for natural restoration of some of the high walls to the extent that they are not barriers to the movement of big game and several other mammals. Due to soil and water changes, it will not be possible to restore some of the suitable habitat for beaver, muskrat, waterfowl, elk, deer, and moose.

Negative mining-related long-term impacts on fisheries will result from stream encroachment, increased sediment, increased nutrients, increased turbidity, accelerated filling of beaver dams, stream-channel changes, increased water temperatures, increased water additives, and complete disruption of segments of some streams. These factors will cause long-term loss of productivity at Blackfoot Narrows, Angus Creek, Georgetown Creek, Stewart Creek, and Maybe Creek. The long-term productivity of the existing fishery resources in much of the area will drop below natural productivity levels.

F. LAND USE

Land use changes will generally be long term. In the short term, however, there will be a loss of forage production from the disturbed land.

The mining areas will be closed to livestock grazing during the life of the mining operations. Spoil dumps, pits, and highwalls will present barriers to traditional livestock movement and grazing systems. Alteration of water sources and quality now suitable for livestock and consumptive use and previously used for agricultural crop production will likely present some long-term management problems.

Available data are inadequate to quantify accurately the long-term loss of livestock forage and agricultural values. However, total productive capacity of the reclaimed lands may be reduced to 50 percent of present levels even with successful revegetation. Additional reclamation techniques must be developed and tested in this climate before any final predictions of success can be made. It may require 50 years or more for plant successions to return these areas to near present productive state because microclimatic and soil structures have been changed; some plant associations may not be able to reestablish themselves on altered sites.

Changes in land use to accommodate urban growth will be long-term. Land removed from agriculture or range to accommodate housing and other urban growth requirements will be lost to future production.

G. RECREATION RESOURCES

The opportunities and quality of outdoor recreation resources on the 936,000 acres of national forest land as well as on other lands within the area will be permanently altered as a result of the proposed actions. The national forest land especially contains high-quality, highly diverse outdoor recreation opportunities and in 1974 provided 420,500 visitor days of outdoor recreation activities, with camping, driving for pleasure, hunting, snowmobiling, and fishing as principal recreation activities.

It is difficult to consider phosphate extraction as a short-term use of man's environment, especially since phosphate mining in the area has been ongoing for years, is currently ongoing and being expanded, and is projected for further rapid expansion. Any changes in the rural, remote characteristics of the area as a result of phosphate mining will adversely affect the quality of this outdoor recreation resource on a long-term to permanent basis.

The proposed phosphate development in the area, combined with related urban services and utility corridors, will involve limited outdoor recreation lands. However, the anticipated total demand from all sources will exert a considerable impact on the existing environment and its excellent quality beyond the boundaries of the proposed development itself.

Reduction in recreation quality will result from mining activity in the immediate area. However, the total effect on the quality of the outdoor recreation experience cannot be specifically determined. It should be noted that the recreation user expects a quality experience. Lowering the quality of such experiences in the study area will tend to displace users to other areas where such experiences can be obtained. Such displacement may necessitate further travel, with accelerated and perhaps over use of such alternative areas as Island Park, Yellowstone and Teton areas as well as American Falls and the Lost Rivers areas.

H. AESTHETIC VALUES

Discordant elements such as noise, odors, and dust introduced by heavy equipment, traffic, and other mining-related activities, will have short-term effects on the aesthetic quality of the area. Landscape changes, on the other hand, will be long-term alterations on the line, form, color, and texture of the environment, resulting in permanent conflicts with the present aesthetic quality of the area.

CHAPTER VII
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

A. DEPLETION OF MINERAL RESOURCES

Based upon mine plans as originally submitted, the total commitment of phosphate rock is 365 million short tons, of which 282 are scheduled for production by the year 2000. Other significant resources included in the 282 short tons of phosphate rock are 6.7 million short tons of fluorine, 250 thousand short tons of vanadium, 31 thousand short tons of uranium, 280 thousand short tons of rare earths, 3.9 thousand short tons of selenium, 17 thousand short tons of zinc, 3.3 thousand short tons cadmium, 110 short tons of silver, and 280 short tons of thallium.

Estimates of energy resources that will be consumed in the period of 1976 to 2000 in the mining, processing, and transportation of phosphate ore, including production from on-going mines, are 140 billion kilowatt-hours of electricity, 273 billion cubic feet of natural gas, 310 thousand short tons of coal, 291 million gallons of diesel fuel, and 16 million gallons of gasoline.

Table 1-47 lists the current use and anticipated commitments of energy and other resources, both within and outside the study area for mining, transportation, and processing of the phosphate rock. Estimated consumption of electricity within the study area, as shown in the table, will increase about 40 percent over the base of the extended current rate. This increase, as well as those for coke, carbon electrodes, and silica, all utilized in the production of elemental phosphorus, reflect the indicated growth in the elemental phosphorus industry.

Consumption of diesel fuel will be nearly doubled, due to an expected general increase in railroad transportation of the ore, but largely due to transportation for processing out of the region. The large increase in gasoline consumption is associated with increased fertilizer production. The overall increase in sulfuric acid is also due to the increase in fertilizer production. The decrease within the study region, however, is related to plans for producing much of the new fertilizer outside of the region. The estimated decrease in the consumption of natural gas, as shown in the table, results from plans to calcine a large part of the new production without the use of gas; much of the ore contains sufficient organic matter to sustain a calcining temperature that will be attained initially with the use of coal.

Resources that will be consumed to the year 2000 in the vanadium processing plant, assuming the current rate of production, are 460 thousand short tons of limestone, 65 thousand short tons of salt, and 65 thousand short tons of soda ash.

Large quantities of rock will be used for railroad roadbed, roads, and concrete aggregate, but the amount thus commited will not significantly deplete the available resources. Unquantified amounts of steel and other construction material also will be required.

At a lower, more probable level of mining, as shown in table 1-1a, there will be a significant reduction in the commitment of resources. Table 1-47a lists the commitment of resources at this lower level. The most significant reduction is that of electric power requirements, down from 48 billion kilowatt hours to 14 billion kilowatt hours. This amounts to an increase of 15 percent over a 24-year period.

These commitments of resources are irretrievable.

B. LANDFORM CHANGES

The creation of 5,900 acres of pits and dumps (3,370 acres of the lesser rate of mining) is largely unavoidable. Although some pits will be backfilled and dumps will be revegetated, the alterations of the landforms will be permanent.

C. SOILS AND VEGETATION

Mixing of soil horizons, thus altering the existing natural soils and changing the characteristics that give each soil its productive capacity, cannot be avoided. Soil properties of texture, structure, pH, and organic-matter content would be irreversibly altered. Assuming that the productive capacity of the pits and waste dumps, even though revegetated, would be reduced to 50 percent of their former capacity, it is doubtful that full production can be restored in areas such as unreclaimed pits. This loss of productive capacity is an irretrievable commitment of resources.

Flora and fauna that depend on native soil associations would be lost or disrupted; existing soil and landform patterns that give the forest and other lands their characteristic landscape and vegetative patterns would be irreversibly lost. Soils covered or altered by mining-related facilities and transportation normally do not revert to their former use, and therefore, can be considered an irreversible and irretrievable commitment of resources.

D. WILDLIFE AND FISHERIES

At either level of mining, some wildlife habitat will be irretrievably lost. Consequent losses of wildlife populations will be irreversible to the extent that displaced animals cannot successfully relocate on adjacent ranges. Based upon mining plans as originally submitted, as much as one-third of the critical habitat for elk will be affected, with an estimated loss of 350 elk. An estimated 3,000 of the wintering deer in the area will be initially lost due to the mining activities. The loss of these deer and elk could ultimately result in a maximum of 19,500 harvestable deer and 1875 harvestable elk being lost over the 25 year life of the mining. It is assumed in these calculations that all of the proposed mines will go into operation during a very short interval of time so that these impacts would be maximized. Alteration or loss of strutting grounds, nesting areas, and brood raising habitats will result in an irretrievable reduction in grouse populations. Populations of raptors, smaller mammals, reptiles, and

Table 1-47.--Estimated Commitment of Resources, 1976 to 2000, based upon mining plans as originally submitted.

		1975 Base Extended to 2000 1/			Anticipated Consumption to 2000 2/			Increase Over Base					
	Units of Measure	Regional	Extra Regional	Total	Regional	Extra Regional	Total	Regional Units	%	Extra Regional Units	%	Total Units	%
Electric Power	Billion KWH	85.0	7.0	92	120	20	140	35	41	13.0	186	48	52.0
Natural Gas	Billion Cubic Feet	280	32	312	240	33	273	-40	-14	1.0	3	-39	-12
Coal	Million Short Tons	0.0	0.0	0.0	310	0.0	310	310	-	0.0	-	310	-
Diesel Fuel	Million Gallons	150	28	178	280	11 3/	291	130	87	-17.	-61	113	63
Gasoline	Million Gallons	8.5	0.1	8.6	15	0.6	16	6.5	76	0.5	510	7.4	86
Coke	Million Short Tons	8.9	0.7	9.6	13	1.0	14	4.1	46	0.3	43	4.4	46
Carbon Electrodes	Thousand Short Tons	220.	19	239.	330	24.	354	110.	50	5.0	26	115	48
Silica	Million Short Tons	8.9	1.0	9.9	14	1.2	15	5.1	57	0.2	20	5.1	52
Sulfuric Acid	Million Short Tons	77	8.9	86.	69	110	179	-8	-10	101	1135	93	110

Notes
1/ Actual 1975 consumption of resources multiplied by 24 years as a datum.
2/ Includes on-going and proposed operations.
3/ Consumption of diesel by Alumet, IMC, and Earth Science.
Outside of region - not included. Amounts are unknown.

Table 1-47a.--Estimated Commitment of Resources, 1976 to 2000, based upon more probable level of mining as shown in table 1-1a.

		1975 Base Extended to 2000 1/			Anticipated Consumption to 2000 2/			Increase Over Base					
	Units of Measure	Regional	Extra Regional	Total	Regional	Extra Regional	Total	Regional Units	%	Extra Regional Units	%	Total Units	%
Electric Power	Billion KWH	85.0	7.0	92	92	14	106	7	8	7.0	100	14	15
Natural Gas	Billion Cubic Feet	280	32	312	376	154	530	96	34	122	381	218	70
Coal	Million Short Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	0.0	-	0.0	-
Diesel Fuel	Million Gallons	150	28	178	215	106	321	65	43	78	279	143	80
Gasoline	Million Gallons	8.5	0.1	8.6	12.2	0.3	12.5	3.7	44	0.2	200	3.9	45
Coke	Million Short Tons	8.9	0.7	9.6	9.4	1.0	10.4	0.5	6	0.3	43	0.8	8
Carbon Electrodes	Thousand Short Tons	220	19	239	234	26	260	14	6	7.0	37	21	9
Silica	Million Short Tons	8.9	1.0	9.9	9.8	1.3	11.1	0.9	10	0.3	30	1.2	12
Sulfuric Acid	Million Short Tons	77	8.9	86.	104	58	162	27	35	49.1	552	76	88

Notes
1/ Actual 1975 consumption of resources multiplied by 24 years as a datum.
2/ Includes on-going and proposed operations.

amphibians also will be irreversibly reduced. These reductions will occur over a 25-year period.

The irreversible alteration or reduction of suitable habitat would impede the recovery and reestablishment of the peregrine falcon and whooping crane.

Increased human activities and related pressures on the wildlife environment will have pronounced irreversible and irretrievable effects on the wildlife resources.

Those transportation and utility systems that affect, encroach on, or alter streambanks and stream channels will cause irreversible damages to the fish populations. Streams covered by waste dumps, channelized, or routed through pipes will also irreversibly reduce fisheries. Reservoirs and lakes receiving water of lower quality and higher sediment will be degraded. Streams irreversibly and irretrievably altered include the Blackfoot River, Angus Creek, Stewart Creek, Maybe Creek, Diamond Creek, and Dry Valley Creek.

The loss of recreation visits, fishing-license sales, creeled fish, or the experience of catch and release fishing because of the altered aquatic environment is irretrievable.

At a more probable level of mining, as shown in table 1-1a, irretrievable losses of wildlife would be reduced to about 200 elk, about 2,300 deer, 1,500 forest grouse, 50 percent fewer sage grouse, and 60 percent fewer waterfowl.

E. LAND USE

Forage production and range availability will be irreversibly lost where revegetation is impossible or impractical. The success of revegetation on disturbed areas will vary, and at least some reduction in productivity can be expected. Based on a 50 percent recovery, the proposed mining operations will result in an irretrievable loss of 1,781 AUMs of grazing annually at the higher level of mining.

The permanent and irreversible loss of naturally occurring springs and seeps and their associated plant communities, in both specific and adjacent areas, will affect livestock use. Increased use of water for industrial and municipal purposes will require reallocation of agriculture and livestock water on a permanent basis.

The change in land use from agriculture and rangeland to urban and suburban use will be both irreversible and irretrievable.

F. ARCHEOLOGIC AND HISTORIC VALUES

All cultural resources are limited and non-renewable portions of the human environment. Any disturbance or destruction of archaeological and historic values are irreversible commitments of these resources.

One way to mitigate the loss of cultural resources is by scientific investigation; an excavation, however, is also an irreversible commitment.

Salvage operations are required when the cultural resources are to be destroyed due to alterations of the physical environment, such as dams, roads or mining. Salvage archaeology is a one-shot attempt to gain as much information as possible from the area before it is destroyed. A problem in salvage archaeology is that the cultural resources found in the process might not fit current research problems and therefore may be passed over as non-valuable resources in the present context. Sites excavated under salvage conditions are completely excavated with no information left available for future studies. Sites which are not excavated are lost forever, with an irreversible commitment of the possible information which they may have contained.

G. OUTDOOR RECREATION AND AESTHETICS

Historically, in areas where development has been fast, land values escalate. This causes keen competition for open space. High land costs and limited available area can curtail or eliminate needed parks and recreation development, particularily by local communities.

At either level, mining and related activities will irreversibly reduce the outdoor recreation opportunities and the aesthetic quality of the area. Reduction in wildlife and fish populations will result in irreversible losses in hunting, and fishing, and related recreation opportunities.

Water, air and noise pollution; man-made intrusions of heavy equipment, conveyors, roads, and utility corridors; dust and smoke; and population increases in the area will irreversibly and irretrievably reduce the quality of both the outdoor recreation opportunities and the aesthetic resources of the area. The remote, open, and undeveloped character of much of the area will be irreversibly and irretrievably altered. Existing life styles, with their emphasis on aesthetics, agriculture and range, and outdoor recreation, would be radically altered.

CHAPTER VIII

ALTERNATIVES

This chapter discusses alternatives that apply generally to the development of the Federal phosphate resources in southeastern Idaho. They include those of an administrative nature as well as alternatives involving substitutes for phosphate, reducing consumption or developing other sources of phosphate, processing technology, plantsite locations, and transportation and utility corridors. The general and administrative alternatives discussed here also apply to, but are not repeated in, Parts 4 through 11 of this statement. Only specific technical and operational alternatives relative to the individual pending proposals are addressed in Chapters VIII of Parts 4 through 11.

Within the study area there now exist 83 leases involving 43,370 acres of land, 4 pending preference-right lease applications on 2,525 acres of land that may become leases, and 1 approved phosphate prospecting permit on 475 acres of land that could culminate in a preference-right lease. All existing leases and the five potential leases provide for development and mining. Therefore, a total of 46,370 acres of land within the study area has been, or may be, committed for development in the short-term future. However, only part of the lease acreage will actually be mined, owing to the geologic environment and orientation of the ore zones. These lands contain an estimated 700 million short tons of the estimated 1 billion short tons of the phosphate reserves in the area.

Although the phosphate on the Federal leases includes about 70 percent of the known reserves, a substantial amount of the reserves is not under Federal control. This has a significant bearing on any Federal efforts to regulate, restrict, or curtail the overall development of the phosphate resources in southeastern Idaho. Any curtailment of development of the Federal mineral estate would be an incentive for a shift in production to State or private resources in response to market conditions. Such production on State or private mineral estate would be subject to State and Federal laws and regulations except the Federal mineral leasing laws, and possibly the National Environmental Policy Act as well.

Proposed mining plans call for the extraction of about 365 million short tons of the Federal reserves. Although some new mine proposals will probably be filed for approval within the next two decades, it is reasonable to assume that the present ongoing operations and the 12 pending new mine proposals, if implemented, represent the major sites to be impacted by mining of Federal mineral estate during the remainder of this century. Any new mining proposals will, of course, be subject to full review under NEPA. To the present, about 816 acres of Federal land and about 1,600 acres of private lands have been disturbed by phosphate mining in the study area. An estimated additional 7,800 acres will be disturbed by the proposed mine pits, waste dumps, and access roads up to the year 2000 if mining proceeds as proposed.

The latitude of discretion available to the Secretary of the Interior in acting on the various proposals and applications varies considerably. Existing leases and prospecting permits are contracts carrying legal rights and obligations for each party. The Secretary must act on applications made under these existing leases and permits, and he cannot abrogate them unilaterally without cause. However, in issuing preference-right leases, approving mining plans, and readjusting lease terms, he has considerable discretion in imposing new requirements or stipulations as appropriate. Congressional action (legislated authorization) would be required for the Secretary to cancel these leases for reasons not already specified in the lease terms.

Applications for prospecting permits, fringe acreage, and competitive leases carry no vested rights, and the Secretary may reject these or approve them under such conditions as he deems appropriate. Also, the Secretary, at his discretion, may offer at any time known phosphate reserves for competitive leasing on such terms and conditions as he deems appropriate.

The alternative courses of action in the phosphate region of southeastern Idaho include areas of development, processing technology, plantsite locations, access routes, and stipulations or requirements on operations. Obviously, if production from Federal lands is curtailed below market needs, production from non-Federal lands, substitution, or reduction in consumption would occur. Stipulations and requirements may be as broad as reasonably necessary to protect the environment and other resources and to achieve reclamation.

I. General Management Alternatives

A. CONTINUED OPERATION OF EXISTING PHOSPHATE PROGRAM IN SOUTHEASTERN IDAHO.

The actions considered in this statement have been proposed by individuals and/or industry under the Mineral Leasing Act of 1920, as amended, and related Federal Regulations. These proposed actions are all on schedules and at sites proposed by the applicants and the lessees, who are requesting the approvals of applications and mining plans by the Secretary of the Interior. Present leasing practice -- response by the Department of the Interior to industry-initiated requests -- has largely prevailed in the past development of the Federal phosphate resources in southeastern Idaho. The existing application for leasing and for prospecting permits discussed in this statement is basically a continuation of this approach.

This approach could be continued in the consideration of the actions currently requiring response. The procedures, consistent with existing regulations, can be environmentally responsive through imposition of special stipulations to approvals of the actions and through avoidance of environmentally-sensitive areas through disapprovals. Such actions would be compatible with the proposed Forest Service land-use plan for the Diamond Creek Planning Unit. Impacts for activities that may be approved are those described in this statement.

B. DEVELOPMENT OF MANAGED PHOSPHATE PROGRAM IN SOUTHEASTERN IDAHO.

Another alternative the Secretary could initiate is the development of a new, closely-managed phosphate program similar to the coal leasing program implemented by the Department of Interior in January, 1976. The new criteria and procedures adopted in May, 1976, relative to evaluation and issuances of preference right leases (30 CFR 3520, 3521) contribute to such a new overall phosphate leasing program. The principal features of such a program would include:

---adoption of a minerals activity recommendation system, which requires careful pre-planning by the Federal land management agencies, and analyses and data to determine the needs for further phosphate leasing.

---adoption of a totally competitive leasing system, under which existing approved prospecting permits and preference right lease applications would be honored, but under which no further prospecting permits would be granted.

---revision and upgrading of the regulations relating to mining and reclamation so as to be comparable with the new coal-related regulations (30 CFR 211 and 43 CFR 3041).

---promulgation of effective diligent development requirements; depending upon specific requirements adopted, this could be applied to existing leases in the long-term.

---establish an exploration licensing option under which resources could be identified and evaluated by industry but which would not entail preference rights to future leases.

Such a program would be based on the principle that only those deposits needed would be leased. Depending on the specifics adopted, such a program could provide the following benefits:

---discourage retention on non-producing leases as excessive reserves or speculative holdings.

---provide timely but orderly development of needed resources.

---confine development of future leases to lands most suitable for mining.

---protect environmentally sensitive areas or values.

---bring more uniformity to the minerals management programs of the Department of the Interior for all minerals.

---allow selective leasing to foster research and development in the technology of mining and processing methods for deep-seated phosphate deposits in Idaho for future underground mining.

---improve the overall capability for management of the Federal lands and resources involved.

Such a program would also impose the following requirements or undesirable effects:

---to the extent that exploration by industry was curtailed, it would impose the burden of exploration and mineral resource evaluation on the Federal government, thereby requiring additional funds and/or personnel.

---to the extent that unleased resources near present mines may be found unsuitable for mining, the cost to industry of leasing and development of new leases in the future could be significantly increased by dispersal of operations, facilities, and ore transportation.

---except to the extent that new diligent development requirements could be imposed by regulations under existing law, and made operable on existing leases (probably only at lease renewal dates) and new more stringent and uniform operating and reclamation regulations were adopted, such a program would not significantly restrict development of the existing 43,370 acres of Federal leases.

II. Management Alternatives Related to Specific Actions

In addition to a general approach to the development of the phosphate resources in southeastern Idaho, there are sets of administrative alternatives for each of the groups of proposed actions.

The following possible alternative course of action relate to the various proposals for development of the phosphate resources in southeastern Idaho:

A. NO ACTION

Because of the variety of proposed actions under consideration and the differing viability of this alternative for individual actions, a single general alternative of no action is not appropriate. The alternative of "no action" is discussed subsequently as it relates to each of the various classes of actions proposed for Federal decision.

B. MINING AND RECLAMATION PLANS

1. NO ACTION

Pursuant to implied covenants of both the Federal mineral leasing laws and the existing lease agreements, the Secretary is obligated to respond to a legitimate application to conduct mining operations on a valid lease provided all terms and conditions thereunder have been met. His response may be approval as proposed, rejection on various legitimate grounds, approval in part and rejection in part, or approval subject to such additional conditions and requirements as he may impose under the laws. He may also defer decision, based on proper grounds, as described elsewhere in this chapter. Failure on the part of the Secretary to act may be challenged in court.

"No action" on proposals for continuation of approved ongoing mining operations would close down existing operations; under existing regulations, operations may not proceed in the absence of approved mining plans and related permits. The impacts of taking no action in such cases would be approximately the same as those described under the following heading 3.b., "Cancel the leases."

"No action" on mining proposals for the initial development of existing leases would maintain the status quo on those leases. The impacts of taking no action in these cases would be the same as described subsequently under "Prevent further development on existing leases."

2. DEFER ACTION

a. For proper cause, the Secretary may defer final action on a proposed mining and reclamation plan. These could include, but are not limited to, the need and time required for:

---modification of the proposal to correct administrative or technologic deficiencies.

---re-design to reduce or avoid environmental impact.

---acquisition of additional data to provide an improved basis for technical or environmental evaluation.

---further evaluation of the proposal and/or alternatives.

---development of an adequate system to monitor impacts for management and regulation.

---no effect on development of existing leases or mine plans.

The principal effect of deferring action on a proposed mining and reclamation plan on these grounds would be a comparatively short-term delay in the imposition of all related impacts of the proposal, both adverse and beneficial, as previously described in Part 1, Chapter V, of this statement.

b. The Secretary also may defer decisions on approval of proposed mining plans which do not contemplate mining of the Federal reserves for a number of years into the future. Approval at this time of mining not scheduled for initiation for perhaps 10 or more years in the future could foreclose the Secretary's options prematurely in the light of fluctuating market conditions, technological progress, and the potential for new regulatory requirements that may not be retroactive. Assuming an acceptable and adequate conclusion of the NEPA process, it would be reasonable for the Secretary to consider approval now of those mine plans that propose a start of production within the next several years and to defer decision on those not scheduled for production until a more distant time in the future, when the need for Federal action is more clearly established. Such action would permit industry response to market demands in the immediate future in conformance with all current applicable environmental safeguards and yet assure application of any future improvement in reclamation and mining technology to the proposed mining at such time as the deferred approvals need to be reconsidered.

Once a mining and reclamation plan is approved, however, the regulations and lease terms do require that all subsequently proposed departures and deviations therefrom be approved in advance by the USGS. The regulations also permit (30 CFR 231.10(e) and (f)) the USGS to direct that changes be made in previously approved operations. For example, changes could be ordered to accommodate new, improved, or revised administrative requirements, technologic improvements, environmental concerns or requirements, or revisions of prior evaluations thereof in the light of experience or previously unknown factors. Such changes, have been ordered routinely in USGS mining supervision practices.

Assuming that the mining and reclamation plans proposed are administratively, technically, and environmentally acceptable under existing conditions and requirements, deferring approval of the plan because of a protracted delay in initiating the planned operation could result in additional economic costs to the lessee or operator, which likely would be passed on to the consumer.

Should the Secretary elect to apply this general option to applicable cases in hand, his specific decisions could include, but not be necessarily restricted to:

---approval in principle now, but refusal of permission to initiate operations pending further administrative, technologic, and environmental review at some prescribed time in advance of proposed starting date, or

---deferral of all consideration until some prescribed time in advance of a proposed starting date, or

---deferral of decision on one or more of the grounds listed above under heading 2.a.

Deferral of approval could likely result in time reduction of long range impacts to the extent that better reclamation techniques may be developed in the interim and could be and required by stipulation at a later date.

3. PREVENT FURTHER DEVELOPMENT ON EXISTING LEASES

The only alternatives to allowing development of existing leases as proposed, is to prevent such development or to impose additional conditions and restrictions on the operations. The several apparent means of preventing full development are discussed below.

If further development of existing leases were prevented, substantial quantities of phosphate, known to be present, would be left in place and not recovered for use. To replace the resources foregone by this alternative course of action, other comparable quantities of phosphate would be required to meet national needs. The development of other sources and the related impacts are discussed later.

a. Suspend operations

The full development of existing leases could be delayed by suspension of operations. If such action were taken, there would be no additional incremental environmental impact on the area, and it would continue in its present condition, subject to further modification by natural processes, the continuation of existing mining activity, and such future uses of the surface as the owners may decide.

The authority of the Secretary of the Interior to suspend operations on existing leases has already been utilized, and future suspensions of operations in southeastern Idaho for reasonable periods, with proper grounds, could be imposed. The Secretary cannot under present circumstances suspend operations to the extent that a de facto cancellation of a lease results unless he seeks and obtains additional authority from Congress. Viability of this option is dependent upon timely legislative action; the option of suspending operations pending legislation remains available. Impacts of this alternative would be similar to those described in subsection 3.b., "Cancel the leases."

b. Cancel the leases (No new development)

The Secretary does not possess authority to unilaterally cancel the existing leases except on the grounds defined therein (Section 6 of the lease terms--"Proceedings in case of default"). The authority to cancel on other grounds would require Congressional authorization for such action as well as for the requisite funds for compensation of the lessees as may be necessary. The Administration has not entered a request for such legislation, and the Congress has not initiated such action in the matters considered in this statement. The possibility of such actions is a matter for further consideration by the Administration and the Congress in the light of this environmental statement and other relevant non-environmental concerns. Such legislative proposals have been initiated by the Administration and/or the Congress in recent years in several other instances, but such legislation has never reached the voting stage. Should such legislation be proposed, it could encompass all or some presently producing leases.

Present production could be interrupted temporarily or terminated completely, as could further development of all existing leases.

To the extent that phosphate production from existing leases was curtailed or halted, alternative sources of phosphate would be required to meet present needs and demands. These could be foreign and/or domestic and are discussed later. The time required to replace the resource foregone could range from scant to a number of years, depending on the specific alternative(s) selected and its state of production.

The direct monetary cost of such action to all parties involved could range from comparatively modest sums to many millions of dollars. Indirect costs to producer, government, and consumer occasioned by contract abrogation, delay in replacement or substitution, displacement of employees, loss of governmental taxes and royalties, loss of employment income, etc., would be substantial in the aggregate.

Such legislation would result in the cessation of further environmental impacts on the Federal leases, concerned, but would likely result in transfer of many of the impacts to lands under private mineral estate. To the extent that the present lessee's could replace the phosphate from the federal leases with phosphate from private mineral estate in the same area, there could be substantial change in long-terms impacts. It is quite likely that there would be additional short-term impacts including plant shutdowns and loss of employment in the interim while such new sources were initially developed.

c. Federal acquisition of leases

The Secretary may acquire existing lease rights case-by-case, for the specific purpose of carrying out his responsibility to conserve threatened or endangered species, under the authority of 16 U.S.C. 1534 (a) (2). The purchase of these lease rights does not, in and of itself, guarantee that these same lands would not be mined at some time in the future; such action would, however, assure that they would not be mined in the immediate future. The actual cost of governmental acquisition of lease rights could range from modest to substantial sums, depending on the value of the resource, the degree to which the individual property figures in the designed operations, and the willingness of the rights-holder to negotiate the sale. Unless specific tracts are identified, it is not possible to evaluate the overall impacts or costs of such an action. Under the cited code, the criteria under which the authority is valid are quite generalized. Based on the data and analyses in this final statement, it does not appear that actions under this authority are a clearly viable alternative. Otherwise, the general ability to acquire the leasehold interest, except by voluntary surrender as provided by the lease terms, is not granted by the existing relevant statutes and would require Congressional authorization for such action as well as for the requisite funds for compensation of the lessees. To date, the Administration has not requested such action, and the Congress has not initiated or considered such legislation; the possibility thereof is thus conjectural at best. The major effects of such Congressional authorization would be similar to those of cancellation of the leases as previously discussed under heading 3.b.

The Secretary could conceiveably retain or acquire mineral rights of existing leases or preference right applications by negotiating an exchange for similar rights. Such a process is not presently defined by regulations, but promulgation of such regulations seems a possibility without further legislative authority. Such an action could involve issuance of non-competitive leases for valuable minerals on other public lands in lieu of the right to mine phosphate now existing here. It is possible that such an exchange could involve other phosphate deposits in Idaho or elsewhere, or other Federal leaseable minerals of comparable value in Idaho or elsewhere. There appears to be no legal impediment to the promulgation of new regulations which would provide that a lessee or preference right applicant may, upon surrender of his right, receive in exchange a lease on other public lands if the exchange is in the public interest. Of pivotal significance would be the rights-holder's willingness to negotiate such an exchange. Until specific tracts are identified, it is not possible to evaluate the overall impact and cost of such an action. Clearly the detailing of resource(s) evaluation and comparative impacts of the two development operations would involve costly and protracted study and negotiation by both the government and the rightholder. Assuming an initial willingness to negotiate the matter, all such studies and analyses would have to be made without any assurance whatever the successful negotiations could be concluded.

d. Reject the mining and reclamation plans.

Rejection of the proposed mining and reclamation plans would result in no environmental impact on the leased lands, and they would continue in their present condition, subject to modification by natural processes and by the continuation of other existing activity and uses, and to further modification by the surface owner to meet other uses.

The Secretary may reject any individual proposed activity that does not meet the prescriptions of applicable law and regulations under his authority, including the potential for environmental impact that could be reduced or avoided by adoption of a significantly different designed course of action by the lessee (operator). The Secretary cannot under present circumstances reject proposed plans to the extent that a de facto cancellation of a lease results unless he seeks and obtains additional authority from Congress. Viability of this option is dependent upon timely legislative action; the option of rejecting the proposed plans pending enactment of such legislation remains available. Impacts of this alternative would be similar to those described under heading 3.b., "Cancel the leases."

4. RESTRICT DEVELOPMENT ON EXISTING LEASES

The subject leases convey the right to develop, produce, and market the Federal phosphate resource thereon, if all other terms and conditions have been met by the lessee. Various measures, which may tend to restrict development, may be taken by the Secretary at any time in the interest of conservation of the resources or in the protection of various specific environmental values in accordance with existing laws such as the National Historic Preservation Act of 1966, and the Endangered Species Act of 1973.

Under present conditions, a general effort to restrict or regulate development of existing leases for most other reasons would constitute a selective application of the "prevent development" alternative already discussed; that discussion, as it relates to impacts, possible litigation, and the need for authorizing legislation, would be relevant in this instance. Other aspects of restricting development are discussed later in this chapter.

5. APPROVE WITH MODIFICATION

a. Extraction methods

Selection of a mining method adaptable to recovering a mineral resource is based upon (1) the spatial characteristics of the deposit (size, shape, attitude, and depth); (2) the physical (or mechanical) properties of the mineral deposit and surrounding rock; (3) ground-water and surface-water conditions; (4) economic factors, including grade of the ore, comparative mining costs, and desired production rates; and (5) environmental factors, such as the preservation of the surface overlying the mine and the prevention of air and water pollution. Of these factors, the spatial characteristics of the deposit and the physical (or mechanical) properties of the mineral and surrounding rock technically and economically limit the methods that can be employed to mine it.

Only open-pit and underground mining are viable methods of mining the phosphate deposits of southeastern Idaho under the existing state of technology and the existing geologic conditions in the area.

Of the 16 mining and reclamation plans proposed for approval, 1 involves underground methods; 15, surface mining. The following discussion briefly describes the most significant criteria that ultimately dictate which method is selected for a given operation. The open-pit method is most effective and most used where ore bodies are at or near the surface and where there is ample suitable location for disposal of overburden within the economic constraints of haul distance. For the Idaho phosphate mines, an especially important consideration in the selection of mining methodology is the physical nature of the ore body itself. As described in chapter II of this part, the ore being mined represents a significantly altered, and therefore softer and weaker, portion of the ore-bearing rock. The earth surrounding the ore body is removed to expose the ore. As the ore is mined at depth, the overburden and middle waste are removed, creating a depression or pit. The ultimate limit of depth of an open-pit mine is an economic limit. This limit is that point at which the cost attributable to recovery of a ton of ore plus the company's profit per ton of ore is equal to the net market value of that ton of ore.

Underground mining usually costs more, per ton of material removed, than open-pit mining. Underground mining becomes competitive when and where open-pit mining reaches a certain limiting stripping ratio.

Underground mining is possible under certain conditions. These include ore strata 6 or more feet in thickness, with uniform dip and strike and minimal faulting; walls, particularly the hanging walls, overlying rock formations that are strong enough to stand with a minimum of artificial support during operations; access by horizontal or nearly horizontal tunnel; and ore amenable to extraction by one of several continuous mining machines now on the market. Underground mining of ore that dips from 12 to 45 degrees is currently avoided. At dips greater than 12 degrees, the slope is too steep for mining machinery to negotiate; at less than 45 degrees, the broken ore will not move downslope by gravity.

Underground mining usually offers the distinct advantage of significantly less impact on the physical environment than that associated with surface mining. Offsetting this are the higher per ton cost of mining previously mentioned and a significantly lower recovery rate of the available resource. Open-pit mining can obtain nearly perfect recovery of ore with minimal dilution, whereas underground mining of phosphate ore results in only 30- to 50-percent expected recovery. Additionally, the accident rate in underground mining is much higher than in open-pit mining.

Although some underground mining tests are currently under way and a gradual movement toward underground mining can be expected as near-surface deposits are depleted, open-pit mining will likely dominate in southeastern Idaho until conditions dictate a change.

b. Alternative reclamation objectives

Most areas disturbed by the mining and related activities will ultimately revert to other land uses. The selection of post-mining land use will be greatly influenced by the land-management agencies concerned during their review and approval of reclamation plans, based on the agencies long term land-use planning objectives and the land-use capabilities. A variety of post-mining and reclamation land uses could be considered. Viable alternatives of postmining uses of the lands of the study area are the return to present uses of grazing, wildlife and fish habitats, water production, recreation, and timber production. New uses could include residential, expanded recreational opportunities, expanded fisheries, more water storage, maintenance of phosphate-ore reserves for deeper or lower grade extraction, and multiple land uses. All such uses would be designed to restore the disturbed land to the best land use or combination of uses practicable, maintain the aesthetics, wildlife, and other resources, and minimize the offsite impacts. Some depreciation of future land-use capabilities will occur. The reclamation of the federal lands will attempt to restore the lands to a degree of productivity compatible with overall land use as determined by the Forest Service and the Bureau of Land Management in their land-use planning for the area. The current land-use plan for the Diamond Creek Planning Unit, being prepared by the Forest Service, considers the mining being proposed on the Caribou National Forest. Reclamation on non-federal lands will also consider the various potential uses of the lands.

Reclamation objectives should maximize future land-use capabilities, aesthetics, and other resources, and minimize offsite impacts. They should be directed toward reestablishment of high-quality vegetation in the shortest possible time and thus enhance and expedite stabilization of the disturbed areas.

Methods that would accomplish the reclamation objectives have been outlined in mitigating measures (Chapter IV). The reclamation methods should be chosen with specific reclamation and land use objectives in mind. After determining best land use or uses through interdisciplinary study and review of each site, methods of reclamation should be applied that would be suited to restoring the disturbed areas to the desired land use, preserving resource values, and avoiding offsite impacts.

Alternative methods for reclamation suggested by the applicants, Federal agencies, or others are summarized briefly here for comparison. Some reclamation methods may not serve all parts of an objective, and tradeoffs in objectives or other reclamation methods may be necessary on a case-by-case basis.

1. Methods to reclaim disturbed areas

(a) Dumps, pits, and roads

Designs shown in some of the mining plans are not sufficiently detailed to determine whether dumps, pits, and roads would all be stable. Foundation site stability, drainage, and other conditions are not known in acceptable detail, as the plans are preliminary in nature. Stabilization of dumps, pits, and roads can be accomplished by methods that apply varying degrees of engineering and administrative controls. Controls similar to those applied to large highway embankments and earth-filled dams should be required. Stabilization of all surfaces and earth masses could be accomplished, but some designs and methods might not satisfy all reclamation objectives. For example, a stable dump could be constructed with the available waste materials if suitable foundation conditions existed, the material was properly placed and compacted, and the side slopes were 3:1. Erosion of the side slopes could be practically eliminated by sufficient rock facing placed on all surfaces. However, revegetation would then be difficult, and the dump might not be aesthetically acceptable.

On the other hand, angle-of-repose free-flowing dumps are much cheaper. They are less stable, having a safety factor of 1 when placed, and are subject to massive failure if saturated or affected by earthquakes or other additional stress. Free-flowing dumps cannot be readily vegetated and are undesirable at many mining sites because of significant offsite hazards.

(b) Surfacing of disturbed areas

Various types of surface treatments have been suggested for the disturbed areas. Topsoiling, revegetation, fertilization, mechanical anchoring, straw or wood mulches, rock mulches, chemical mulches, rip rap, contouring, and benches, have been recommended for specific sites. Some of these are compatible with post-mining land use objectives; others are not.

(c) Revegetation

Revegetation is discussed in Chapter IV. Proposed types of vegetation include varied trees, shrubs, and grasses; these would probably comprise native and exotic species where microconditions indicate. The suggested methods of planting, cultivation, and care would achieve desired density and surface cover. Plant establishment would probably require topsoil, soil preparation, fertilization, innoculation with microorganisms, and irrigation.

(d) Water control

Various water-control devices have been proposed. They include ditches, pipes, culverts, trenches, French drains, tile drains, rock-lined channels, gutters, dams, ponds, benching, well points, pumping, underground recharge, surface-storage reservoirs, irrigation, discharge to the natural ground, discharge to existing streams, pumping to replace losses in the mining areas, and discharge into mine dumps, behind mine dumps, and into backfills. Water-control devices selected should be designed to accommodate peak runoff.

(e) Sediment control

Sediment-control measures of various types have been proposed. They include retention ponds, benches, slope control, filtration, revegetation, mulching, buffer and filtration strips, brush dams, dikes, large reservoirs, mechanical stabilization, ground-water infiltration, French drains, diversion into the natural ground through energy-dissipating devices, rock facing and other linings for channels, erosion-control gutters, collection of surface runoff in collection areas behind waste dumps, monitoring, and floodprotection works to alleviate impacts on quality of water. Not all of these methods will be equally effective in preventing offsite impacts.

2. Administrative controls

Approval of revegetation plans will be contingent upon acceptable objectives for percentage of ground cover, realistic times for accomplishment, and other criteria.

Monitoring of water quality should be accompanied by plans for action and time limitations for corrective action when acceptable levels of sediment or chemical quality are exceeded.

d. Impose additional mitigating measures

This alternative constitutes the only practical means by which the adverse environmental impacts of the operations, as proposed, could be further reduced while simultaneously maximizing the full development and ultimate conservation of the resource and allowing the lessees the full enjoyment of their rights. The chapters on mitigating measures in the individual parts of this statement discuss the terms and conditions of existing leases, those attendent to the issuance of subsequent permits and authorizations required under existing regulations, and the Federal supervision which will be imposed thereunder.

Chapter IV, "Mitigating measures", in this part (Part I), describes general requirements which, if imposed, would minimize environmental impacts of the various proposals. More specific measures that could be imposed on a case-by-case basis are discussed in parts 4 through 11. Such additional mitigating measures, determined to be feasible and desirable by the land-management agencies and the USGS District Mining Supervisor, before a mining plan is approved, may be imposed as a condition of that approval. The lease terms and governing regulations permit imposing further modification after approval and at any time during operations when actual conditions dictate the need. In addition to those site specific mitigating measures discussed in Chapters IV of Parts 1 through 11, including Federal, State, and local laws, there are more general mitigating measures that could be stipulated as conditions of approval of the development of the Federal phosphate resources. One such stipulation could be the development of a coordinated program in the phosphate region to monitor the long-range impacts and to provide timely data to industry, planning agencies, and to agencies having regulatory authority over mining, reclamation, and processing. Another such stipulation could require concurrent consideration by appropriate agencies at all levels of government through a coordinated review procedure prior to action on permits, leases, or mining plans. Although not specifically required by existing law, the program recommended by the State Historic Preservation Officer and the State Archeologist, as outlined in Chapter IV, could be stipulated as a regional requirement prior to approval of expanded operations in the region.

In addition to onsite mitigation, in order to compensate for adverse impacts on wildlife habitat and the related ecologic ramifications, as detailed elsewhere in this statement, the Secretary could purchase comparable land or designate other Federal lands under his jurisdiction adjoining or separate from the lands subject to existing rights. The comparable lands could be used to provide replacement habitat and ecologic conditions, or for uses of the public lands that could be lost due to the exercise of vested mineral rights. Exercise of this option to purchase land would likely require legislative authority, including appropriation of the requisite funds to obtain comparable lands. The option presumes that the replacement lands would be occupied by wildlife displaced by mining or that wildlife and habitat on the replacement lands would be upgraded to compensate for that lost to mining in addition to maintenance of its initial (present) habitat or populations, and/or other uses of public lands to be lost to mining. Such a course of action would be at best offset only some of the environmental and none of the socioeconomic, cultural, or physical impacts of the exercise of rights already earned or conveyed. To date, no Administration has requested such legislation, and the Congress has not initiated such legislation; the possibility thereof is conjectural at best.

6. APPROVE THE MINING PLANS AS SUBMITTED

Approval of a mining plan as submitted would result in impacts as described in Parts 4 through 11. However, at this time, only one of the 16 proposed mining plans contains sufficient engineering details for final consideration for approval under Federal Regulations 30 CFR 231. Partial approval of the rest, however, could be given, subject to submission of the required additional information and compliance with the requirements of Federal Regulations 30 CFR 231 for final approval.

C. FEDERAL LEASING AND PROSPECTING PERMIT APPLICATIONS

A variety of options are available to the Secretary of the Interior when considering applications for phosphate prospecting permits and leases under the Mineral Leasing Act. In this section, five different types of action are addressed: (1) prospecting-permit applications; (2) preference-right lease applications; (3) competitive-lease applications; (4) fringe-acreage applications; and (5) re-adjustment of lease terms and conditions. The last named is provided for by the terms of the lease. The issuance of preference-right leases, if the application is valid in all respects, is essentially a non-discretionary action under the leasing laws. In the matter of prospecting permits and competitive-lease and fringe-acreage lease applications, the Secretary has full discretion in his action thereon. He may respond either on a case-by-case basis or through a developed program approach such as that for coal leasing.

In considering the applications for prospecting permits and new competitive leases, the Secretary may issue or deny approval so as to regulate future development as to both acreage and locations. He may also declare a moratorium on such issuances if appropriate, as was recently done on the Federal coal reserves.

In southeastern Idaho, such issuance could be predicated upon a policy of maximum resource development commensurate with minimum environmental impact. Further prospecting in southeastern Idaho, if desirable, could be limited to those areas of least environmental impact. Part 2 identifies nine general areas and the impacts associated with prospecting and possible mining in each of them. Of these areas, the more significantly impacted are the Aspen Range area, the Webster Range areas, and the Crow Creek area. The environmental impacts are discussed in Part 2.

1. NO ACTION

With respect to preference-right-lease applications, if the application is valid in all respects, and if discovery of a valuable deposit has been demonstrated in accordance with existing regulations

(43 CFR 3520 and 3521 as Amended May 7, 1976), this lease will be issued. (See discussion of the procedure in Part 2, Chapter 1). In this procedure the Secretary will attach such terms and conditions as may be necessary to assure maximum environmental protection and the protection of the public interest. Having issued a prospecting permit, the Secretary is obligated to act on any resulting preference right applications. Thus, the alternative of "no action" is not viable or reasonable if the applicant has met all the requirements of the regulations. It is possible that the Congress could enact legislation that would alter present circumstances in one way or another. However, to date the Administration has not requested such action, and the Congress has not initiated or considered such legislation; the possibility thereof is conjectural at best. If legislation were passed which cancelled all existing prospecting permits and preference-right-lease applications, the effects would be similar to those previously described under heading 3.b. of this chapter, entitled "Cancel the leases."

If the Secretary so elects, he need take no action on pending prospecting-permit, competitive-lease, or fringe-acreage lease applications. Under existing law, he is empowered to approve such applications but is not required to do so in any given instance. The results of taking no action on the existing application would be to preclude additional incremental environmental impacts on the area from mining operations on the mineral properties under application. Those properties would continue in their present conditions, subject to further modification by natural processes and such other uses as the land-managing agencies may elect or permit. To the extent that production of phosphate from the properties would be foregone, alternative sources would be required to meet the need. Alternative sources of phosphate and the related impacts are described later in this chapter. Other effects would be: (1) little or no additional geologic and mineralogic information would be obtained in presently unexplored areas; (2) the future value of present leases and the non-federally-owned deposits would appreciate; (3) mining of the Federal resource beyond present lease boundaries would be precluded and would preserve the resource for the future; (4) operators with limited ore reserves would either cease operations in a short time or seek other available sources; (5) operators with substantial ore reserves could significantly influence future production and location of phosphate mining in Idaho; and (6) mining in the more remote areas now under lease possibly would be accelerated.

By taking no action on pending or future prospecting-permit applications, the Secretary would preclude any loss of his discretion in future leasing actions but would simultaneously increase the cost to the government for evaluating the resource and processing all future lease sales. Under such conditions, it would be necessary for the Government rather than permittees to obtain the minerals exploration data needed to evaluate the mineral deposit proposed for sale.

For practical purposes, implementing the "no action" alternatives would contribute to "preventing further development" and would have the same result as "rejecting the applications."

Under the terms of Section 3, (e) of the lease, the lessor reserves the right to readjust the terms of the lease, including, among others, royalty rates and environmental requirements, at 20-year intervals. The exercise of that right is discretionary, and it would be appropriate to presume that some affirmative action will take place in this regard. The effects of taking no action to readjust lease terms would be to forego modernizing the lease terms and increasing royalty rates, when appropriate, to the general benefit of the public interest.

2. REJECT THE APPLICATIONS

This alternative differs from the preceding "no action" alternative only to the extent that a discrete administrative action is taken in response to the applications for prospecting permits and various types of leases. The same constraints would apply to discrete rejection, and the same impacts would flow from rejection as from "no action."

3. DEFER ACTION ON APPLICATION

For a temporary period, this alternative has already been utilized. For example, actions relative to permit and lease applications and the readjustment of terms and conditions have been stayed pending the completion of this environmental impact statement.

In the short-term, the Secretary may defer action on preference-right lease applications on other proper grounds. These could include, but not be limited to the need and time required for:

---modification of the proposal to correct administrative or technologic deficiencies.

---redefinition of the acreage involved to avoid unacceptable environmental impact of future development.

---acquisition of additional data to provide an improved basis for technical or environmental evaluation.

---further evaluation of the proposal and/or alternatives. The principal effect of deferring action on such applications would be a comparatively short-term delay in the imposition of all related impacts of the proposal, both adverse and beneficial.

In the long-term, this alternative is subject to the same constraints and would result in the same impacts as described in the preceding subsection on "no action."

4. IMPOSE NEW GENERAL TERMS AND CONDITIONS ON PROSPECTING PERMITS AND LEASES

The present general terms and conditions of the phosphate permits and leases are derived basically from the Mineral Leasing Act of

1920, as amended, and amplified by regulations of the Secretary of the Interior.

Within present statutory restraints of the Mineral Leasing Act of 1920, as amended, the Secretary of the Interior may impose terms and conditions to permits and leases. Basically, this broad authority vested in the Secretary of the Interior relates to exploration and mining operations under permits and leases, respectively. New regulations or operating directions could be issued whereby more stringent terms and conditions would be imposed. Such action is presently pending under proposed regulations for surface management and mining operations on Federal coal deposits.

New general terms and conditions relative to the acquisition, exploration, development, extraction, and reclamation of Federal phosphate deposits could also be directed by new or amendatory legislation.

With respect to prospecting permits, broad authority is vested in the Secretary to promulgate regulations to govern explorations under such permits. Additionally, a wide variety of conditions of approval may also be applied on a case-by-case basis. Those which will or could be imposed on those applications now pending have been identified in Chapters IV, "Mitigating Measures," in Parts 1 and 2 of this statement.

5. APPROVE THE APPLICATIONS

Approval of the prospecting permits would open the Western Phosphate Field to further leasing at the discretion of industry in locations of their selection. Based upon past experience of conversion of permits to leases, it would likely increase the extent of federal leases from 43,370 acres to perhaps 51,000 or more, thereby committing an additional 8,500 acres to future mining.

Approval, if granted, would have to be programmatic rather than site-specific, inasmuch as site-specific environmental analyses and supplemental environmental statements as necessary, have not been performed on an application-by-application basis. Under this general approval, each of the applications would require an individual analysis to determine site-specific impacts, and may not be issued if impacts are determined unacceptable. The analysis of overall impacts as described herein, however, are sufficient for overall consideration of a program of issuance of prospecting permits.

D. ALTERNATIVE USE OR REDUCTION OF USE

1. SUBSTITUTE FOR PHOSPHATE

Because phosphate is an essential constituent of all living matter, there is no substitute material for its uses in fertilizer and animal feed, which constitute about 85 percent of the U.S. phosphate market.

The use of phosphate in detergents has decreased in the last few years to about 5 percent of the market. It may not decrease much more, owing to the lack of satisfactory substitutes. The amount used may be regulated by State of Federal statutes.

The remaining 10 percent of the marketed phosphate is utilized for many purposes; this amount is not likely to change appreciably.

2. REDUCTION IN USE OF PHOSPHATE FERTILIZER

Because current food-crop productivity is dependent upon phosphate fertilizer, only a limited reduction in the level of fertilizer use is possible without a consequential reduction in food production. If sewage sludge could be used for fertilizer and if livestock manure could be applied to farmlands, some reduction in the production of phosphate rock and commercial fertilizer could be achieved. Any substantial reduction in the use of commercial fertilizer, and subsequent reduction in unit-area production, would require cultivation of larger acreages to maintain production levels. Some small voluntary reduction in consumption because of the resultant ultimate economic impact on agriculture might be accomplished. However, in view of world food requirements, legislated reduction of fertilizer production would appear to be inconsistent with national policy. The possibility of such legislation thus appears to be unlikely and conjectural at best.

E. ALTERNATIVE SOURCES OF PHOSPHATE

1. SHORT-TERM SOURCES

Alternative short-term sources of the phosphate rock expected to be produced from the proposed mines are other deposits in the Phosphoria Formation in Utah, Wyoming, and Montana and the deposits in Florida, North Carolina, and California,, including those in the Osceola and Los Padres National Forest, for which environmental statements have been prepared. This alternative would ignore the fact that the deposits of the study area are the richest in the United States and will produce the most short tons of P_2O_5 per acre of land surface per unit of phosphate mined. Additional production from other domestic deposits would increase or create environmental impacts in those areas. A second alternative short-term source could be effected by the reduction of exports of Florida phosphate rock. This option could result in an adverse effect upon the Nation's balance of payments and would require the imposition of governmental control on phosphate marketing. A third option is increased imports of phosphate rock from other countries. This too could result in an adverse effect upon the balance of payments and tend to make the United States dependent upon foreign sources for yet another mineral commodity. The substitution of such short-term sources for the proposed southeastern Idaho production would temporarily transfer the associated impacts to the sites of such sources.

2. LONG-TERM SOURCES

Alternative long-term sources are: (1) underground mining of the deposits of the study area that lie below the depth attainable by open-pit methods and (2) other domestic deposits--those known as well as those that may be discovered in the future. Phosphate resources under this area amount to many billions of short tons. Underground mining is desirable because the disturbance of the land surface is minimal. It is unlikely that phosphate deposits comparable in quantity and quality to those in the study area will be found. Low-grade deposits, not now economically minable, have the undesirable impact of greater disturbance of the land surface per unit of phosphate recovered. The disadvantages of foreign imports are the same as those described above for "short-term sources." Offshore sea-bottom deposits on the Atlantic and Pacific continental shelves appear to be large, possibly totaling a few billion short tons, but sea-bottom mining is in the experimental stage and environmental effects of such mining are largely unassessed. Recovery of phosphate from sewage effluent and sludge and recycling of phosphate are highly desirable but can account for only a small part of the total demand. The phosphate in municipal sewage in the United States amounts to less than 1 million short tons of P_2O_5 per year, about 2 percent of present demands. Phosphate is now extracted from sewage effluent but is not utilized.

F. ALTERNATIVE PROCESSING TECHNOLOGY

The combination of processing steps and handling operations in both elemental phosphorus and fertilizer plants are far too complex to expect their replacement by a completely different method of processing. However, alternate processing steps might lead to an overall improved process which would be more compatible with the surrounding environment. The following is a list of potential alternatives that could possibly be adopted in operating plants. As yet, none of these have been tested at an industrial-plant scale within the United States, and thus they represent only potential future processing alternatives.

1. BENEFICIATION

a. Froth flotation

Froth flotation, is an integral part of washing-sizing beneficiation plants; it provides for increased phosphate recovery (presently about 30 percent of the P_2O_5 is lost in the tailings) and allows utilization of unaltered rock and low-grade shales containing from 15 to 20 percent P_2O_5. Improved recoveries would result in proportionally less tailings and reduce the magnitude of the disposal problem.

b. Dry beneficiation

Dry beneficiation, which involves dry scrubbing and sizing, would completely eliminate the need for tailings ponds.

c. Dry-slurry treatment

Dry-slurry treatment is a process that uses conventional wet beneficiation but includes dewatering of the final tailings to about 40- to 50-percent solids rather than the 6- to 10-percent solids left in tailings by present conventional methods. Partial dewatering of the tailings would greatly reduce the acreage requirements for tailings ponds.

d. Direct sulfuric-acid digestion

Direct sulfuric-acid digestion of the entire phosphate matrix without prior beneficiation could eliminate beneficiation completely and provide a significant increase in overall phosphate recovery. This approach is being researched for application on Florida phosphate matrix by the U.S. Bureau of Mines (USBM), Albany Metallurgy Research Center, Albany, Oreg. This method is designed to eliminate the slimes problem characteristics of Florida phosphates but would have little environmental benefit if applied to Idaho material. However, this method would permit the processing of lower grade ores with higher recoveries and better utilization of resources.

2. CALCINING

a. Carbon removal by wet oxidation

Calcining of phosphate rock at the fertilizer plants is for removal of organic carbon to prevent foaming in the sulfuric-acid digestion step and to prevent discoloration of the phosphoric acid produced. Organic carbon could be removed by a wet-oxidation method with oxidizing agents, such as permanganate, sodium hypochlorite, or ozone. Thus, this would eliminate heat treating and accompanying evolution of fluorine and other gases during this pretreatment stage.

3. PRODUCTION OF PHOSPHORIC ACID

a. Phosphoric-acid digestion

In place of sulfuric-acid digestion of phosphate rock, the rock could be digested in excess phosphoric acid, followed by a low-temperature (160 to 180 degree C) steaming operation to evolve and remove the fluorine in one initial step. The resulting defluorinated monocalcium phosphate slurry can then be reacted with sulfuric acid to precipitate the calcium as gypsum, which can then be separated by filtration (USBM research). This process removes essentially all of the contained fluorine in one initial step rather than passing it on to the gypsum residue and final fertilizer product. About 80 percent would be recovered as fluosilicic acid; about 20 percent recycled back through the acidulation process. Essentially, this results in little or no fluorine going to the gypsum ponds and reduced potential for escape into the environment.

b. Hydrochloric-acid digestion

Hydrochloric-acid digestion of phosphate rock is followed by solvent extraction to produce phosphoric acid. A fluorine byproduct could be recovered from the waste liquor (USBM research). The process has not been completely tested, and toxic environmental emissions, including chlorine, remain uncertain.

4. TRIPLE SUPERPHOSPHATE PRODUCTION

This process would require acidulation of phosphate rock with excess phosphoric acid followed by drying, granulation, and heat curing at low temperature (160 to 180 degress C) to evolve and recover fluorine. Resulting monocalcium phosphate can be treated to neutralize excess phosphoric acid and prepared as a defluorinated triple superphosphate (new USBM research). This process would remove the contained fluorine in one initial step, and hopefully it will produce a fluorine-free triple super-phosphate product suitable for animal-feed supplement.

5. AMMONIUM PHOSPHATE-TYPE FERTILIZER PRODUCTION

Lowgrade Idaho phosphate rock could be shipped out of the area for use as an absorbent for sulphur dioxide emitted from coal-burning electric generating plants; it could then be combined with anhydrous ammonia to produce a liquid ammonium-phosphate fertilizer as a profitable byproduct. (Process developed jointly by the Illinois Institute of Technology and the Purity Corporation.)

6. THERMAL PROCESSING

There is no known alternative for producing elemental phosphorus other than by high-temperature thermal reduction. However, since much of the elemental phosphorous goes into the manufacture of high-grade phosphate chemicals, wet-process phosphoric acid could be used as a substitute if it were purified sufficiently by ion exchange, liquid-liquid extraction, selective precipitation, or a combination of purifying processes. Shortages of electrical power required for thermal reduction may hasten conversion to the wet process for production of phosphate chemicals. This process would eliminate high-temperature gaseous emissions.

Several of the foregoing alternatives include removal and recovery of fluorine in the initial stages of processing, thus minimizing or eliminating any change for environmental contamination by fluorine and providing a valuable domestic byproduct source of fluorine. Currently about 70 percent of the fluorine consumed in the United States is imported from foreign sources. Fluorine recovered from phosphate as fluosilicic acid can be processed to produce anhydrous hydrofluoric acid or other usable products.

Much fluorspar is consumed as a flux conditioning agent in steelmaking. A substitute product could be prepared by neutralizing fluosilicic acid from phosphates with appropriate additions of lime, producing a mixture of calcium fluoride (fluorspar) and silica containing about 70-percent calcium fluoride equivalent. The product is being tested as a substitute for natural fluorspar by USBM as a slag conditioner in steel-making.

G. ALTERNATIVE PROCESSINGPLANT LOCATIONS

All existing and proposed phosphate-processing-plant locations are on private lands. The Departments of the Interior and Agriculture have no control over the plant locations or their design and, therefore, can serve only in advisory capacity in suggesting viable alternatives. Ultimate control is in the domain of the State and local planning or regulatory authorities as the plants must be in compliance with county and/or city-zoning regulations and Federal and State air- and water-quality standards.

According to the air-quality study conducted for the task force, the primary impact on air quality due to the further development of phosphate resources in southeastern Idaho over the next two decades would be from the operation and growth of existing elemental phosphorus and fertilizer plants. They do not presently meet, nor are they expected to fully meet Idaho's air-quality standards for SO_2, fluorine, or particulate emissions by the year 1995. Similiarly, the four new beneficiation plants scheduled during the next two decades, if similar to the existing plants, would meet the present standards for these plant emissions, short-term or long-term. In all present cases, the standards are not exceeded outside of an area extending a few kilometres from any given plantsite, under normal meteorological conditions.

In view of the existing and projected quality of the environment in the Soda Springs area, combined with socioeconomic considerations and aesthetics, consideration should be given to relocation of three proposed plantsites in the Diamond Creek, Dry Valley, and China Hat areas to the Soda Springs-Conda area. In so doing, a sound plant dispersal plan could be adopted to insure compliance with air- and water-quality standards and eliminate cumulative effects on the quality of the environment.

Substantial differences in potential environmental impacts exist between the plantsite-location concepts as proposed by the operating companies and those suggested by the task force. Locating the plants at or near the minesites in areas of high environmental sensitivity would have a high overall impact on the local environment as previously described in this statement.

Conversely, locating the three plantsites on a dispersed basis in the Soda Springs-Conda area, where plants already exist, would preclude such impacts on the presently-undeveloped environment and place them in areas already committed to such development. Transportation and socioeconomic considerations also favor consolidation of new plants on a well-planned, dispersed basis in the Soda Springs-Conda area. The plantsites, however, would have to be sufficiently separated and so located with necessary safeguards as to comply with air- and water-quality standards. A final selection of a plantsite for the Paris-Bloomington operation has not been made.

H. ALTERNATIVE TRANSPORTATION/UTILITY CORRIDORS

An extensive discussion of alternatives for general transportation and utilities systems that serve the phosphate region in southeastern Idaho exceeds the scope of this statement. However, this regional statement will serve as the basis for site-specific assessments or supplemental statements as needed for future specific phosphate-related transportation and utility proposals.

Various agencies and authorities are continually analyzing each component of the transportation and utilities systems of the area to determine where improvements, expansions, and additions are necessary to meet current and future demands.

An agency actively involved in this process is the Idaho Transportation Department (ITD). One of its primary responsibilities is to develop and administer the State highway system and, pursuant to this, to carry out the planning necessary to achieve an equitable balance between the social, environmental, and economic aspects related to highway development.

Ongoing activities of the ITD that impinge on phosphate mining and processing in the region include eventual widening and paving of the Freedom-Wayan segment of State Highway 34, completion of the Fish Creek Cutoff from Lava Hot Springs to Soda Springs, widening the road from Soda Springs to the Monsanto Company plant to four lanes, and construction of a railroad overpass in Soda Springs to facilitate traffic flows primarily generated by phosphate mining and processing to the north. Prior to action on each of these developments, an environmental assessment was or will be prepared by the ITD which includes an analysis of the alternatives. Future developments will be handled by ITD in a similar manner, with public comment being solicited for all projects which significantly affect the environment.

The proposed expansion of phosphate mining and phosphate-processing-plant capacities and the proposed construction of new plants in the future will create a demand for large amounts of additional power. The power companies that supply electricity to the region form part of a complex interconnected system encompassing most of the Western United States and portions of southern Canada. However, each utility company is granted an exclusive franchise by its respective State Public Utilities Commission to supply customer needs within its service area. Exchanges of electrical power and short-term sales of electricity commonly occur between utilities, but yearly increase in electrical consumption within each service area precludes long-term commitments by the companies. The goal of each company is self-sufficiency through development of additional generating capability as demand grows. Continuous long-range planning by each company is necessary to insure that generating capability keeps pace with increased power demands such as that resulting from expanded phosphate operations.

It is beyond the scope of this statement and, in fact, premature to conduct a rigorous analysis of various major alternative utility corridors in southeastern Idaho that may be used or required to serve the phosphate region in the future. More or higher capacity powerlines will be needed to meet future demands for all purposes in the area, necessitating further environmental assessment and preparation of applicable environmental assessments or impact statements by State and/or Federal agencies concerned.

Chapter VIII of Part 3 discusses alternative transportation and utilities routes for those systems directly related to the proposed mining operations.

I. RESTRICT OR REGULATE ADDITIONAL DEVELOPMENT

As discussed under heading B.4. of this chapter, no general authority exists to restrict development on existing leases. It is conceivable, however, that various conditions of approval attached to proposed exploration and development designed to avoid unacceptable environmental impact could serve to restrict or preclude development of part or all of an existing lease. Such conditions could include, for example, stipulations imposed to accommodate requirements of the Endangered Species Act, the National Historic Preservation Act, or air and water quality permits.

Additional development of Federal minerals not now under permit or lease can be restricted or regulated to a degree by exercise of the Secretary's discretion in the approval and issuance of pending or future prospecting permits, competitive leases, and fringe-acreage leases.

CHAPTER IX
CONSULTATION AND COORDINATION WITH OTHERS

Development of statement

This environmental impact statement was prepared by a Federal interagency task force under the leadership of the U.S. Geological Survey, with major inputs from the U.S. Forest Service and the Bureau of Land Management. Other Federal agencies providing consultation and/or contribution to the preparation of this statement include the following:

U.S. Fish and Wildlife Service
Bureau of Outdoor Recreation
Bureau of Mines
Environmental Protection Agency
National Oceanic and Atmospheric Administration
Mining Enforcement and Safety Administration

Data, information, and/or other assistance were obtained from the following State agencies:

Idaho Department of Health and Welfare, Division of Environment
Idaho Fish and Game Department
Idaho Department of Water Resources
Idaho Bureau of Mines and Geology
Idaho Department of Transportation, Division of Highways
Idaho Department of Agriculture
Idaho Department of Parks and Recreation
Idaho Department of Lands
Idaho Bureau of State Planning and Community Affairs
Idaho Water Administration Board
Idaho State Archeologist
Idaho State Historic Preservation Officer

Additional participation and assistance were obtained from many sources. The eight companies proposing mining provided data and information on their proposed activities. The Union Pacific Railroad provided, for task-force consideration, much assistance on transportation facilities for ore haulage; the Utah Power and Light Company and the Idaho Power Company did likewise on utility systems. Officials and employees of local and county governments, SICOG, and universities also provided data and assistance. Comments of residents of the area, environmentalists, and others were also helpful to the task force in the preparation of this document.

Review of statement

In accordance with the CEQ guidelines, copies of the draft statement are available to the public for their comments and suggestions. In addition, comments are being solicited from the following:

Federal agencies

- Soil Conservation Service
- Federal Power Commission
- Department of Health, Education, and Welfare
- Interstate Commerce Commission
- Department of Transportation
- Nuclear Regulatory Commission
- Energy Research and Development Agency
- Environmental Protection Agency
- Department of the Interior
  - Bureau of Reclamation
  - National Park Service
  - Mining Enforcement and Safety Administration
  - Bonneville Power Administration
  - U.S. Fish and Wildlife Service
  - Bureau of Mines
  - Bureau of Outdoor Recreation

State and local agencies

- Idaho Department of Health and Welfare
- Idaho Department of Water Resources
- Idaho Fish and Game Department
- Idaho Department of Lands
- Idaho Department of Parks and Recreation
- Idaho Department of Agriculture
- Idaho Department of Education
- Idaho Department of Employment
- Idaho Public Utilities Commission
- Idaho Bureau of Mines and Geology
- Idaho Bureau of State Planning and Community Affairs
- Idaho Division of Policy Planning and Coordination
- Idaho State Archeologist
- Idaho Historic Preservation Officer
- Board of County Commissioners, Bannock County
- Board of County Commissioners, Bear Lake County
- Board of County Commissioners, Bingham County
- Board of County Commissioners, Bonneville County
- Board of County Commissioners, Caribou County
- Board of County Commissioners, Franklin County
- Board of County Commissioners, Oneida County
- Board of County Commissioners, Power County
- Mayor, City of Pocatello
- Mayor, City of Idaho Falls
- Mayor, City of Soda Springs
- Mayor, City of Montpelier
- Southeast Idaho Council of Governments
- Bonneville Council of Governments
- Bear Lake Regional Commission

Applicants

Alumet Group
Beker Industries Corporation
Earth Sciences, Inc.
FMC Corporation
International Minerals and Chemical Corporation
Monsanto Company
J. R. Simplot Company
Stauffer Chemical Company

Additional copies will be made available to the general public for inspection and review as announced in the notice of availability in the *Federal Register* at the time the document is released.

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PART 2

PENDING APPLICATIONS FOR PROSPECTING PERMITS, LEASES, FRINGE ACREAGES, AND TWENTY-YEAR READJUSTMENTS OF LEASES

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CHAPTER I

DESCRIPTION OF ACTION UNDER CONSIDERATION

INTRODUCTION

This part considers the permit and lease applications pending before the BLM, USGS, and Forest Service and the readjustment of terms on leases over 20 years old. Collectively, these applications constitute an important issue: they involve well over 100,000 acres, and the issuance of permits and leases will result in exploration, development, or mining on all or part of this land.

Once the land has been leased, the Federal government is legally committed to allow mining on the leased properties. At that point, the Secretary of the Interior has the authority only to decide whether the mine plans, as proposed, are acceptable. By contrast, in deciding whether to approve applications for prospecting permits and competitive leases, the Secretary of the Interior has the authority to decide whether more land should be committed to phosphate mining, how much land should be committed, and when such commitments should be made. Because these decisions are the first step in the process which eventually leads to mining and the last step at which the Federal government has full discretion, they are of major importance.

Federal phosphate leases are obtained either (1) non-competitively, through a phosphate prospecting permit leading to the issuance of a preference-right lease; or (2) by submitting the highest acceptable bonus bid at a competitive lease sale. A permit or lease gives the permittee or lessee the right to explore and/or mine subject to the approval of an exploration or mining plan. The federal agencies responsible for managing the surface and subsurface resources must consider the potential effects on these resources before issuing permits or leases.

Prospecting permit applications are filed with State office of the BLM, which reviews the applications and refers them to the USGS. The USGS then prepares a mineral classification report and submits to the BLM its recommendations for issuance or rejection, including stipulations on exploration. If the land is classified for leasing because of already known phosphate deposits, the BLM rejects the application. If the lands are not classified for leasing, the application is referred to the appropriate surface management agency, ordinarily the Forest Service or the District office of the BLM. The surface management agency, in cooperation with the USGS, makes a technical examination pursuant to Federal Regulations 43 CFR Part 23 and prepares an environmental analysis report. Reports and recommendations, with suggested special stipulations, are referred to the BLM State office, which either rejects the application or issues a permit subject to agreed-upon stipulations. Prior to any surface disturbance or exploration activity the permittee submits a plan of exploration and reclamation to the USGS, which in turn prepares an environmental analysis. The plan and analysis go to the appropriate surface management agency for review and recommendations. With agreement from the appropriate agency, the USGS approves the plan. An application for a preference-right lease is filed with the BLM State office. On May 7, 1976, the Department of the Interior published final rulemaking which substantially revised the procedures for evaluation and processing such applications by revising 43 CFR 3520, 3521 (41 FR 18845).

Summarized in general terms, under the revised regulations, the application-evaluation process has been divided into two phases. In the initial phase the applicant submits reserve information, describes the physical characteristics of the area covered by the permit, and describes his proposed mining operation. Based upon this information the Department does a technical examination/environmental analysis of the area covered by the permit, and prepares appropriate lease terms and stipulations. The proposed terms and stipulations are given to the permittee, and based on this information he must make a final showing of estimated revenues and all the estimated costs that a prudent person would consider before deciding to operate a mine. These costs include the cost of developing and operating the mine, processing and product transportation, royalties and taxes, and the costs of complying with existing governmental regulations, reclamation and environmental standards, and the proposed lease terms and stipulations. If the cost of mining exceeds the value of the deposit, the lease application is denied; if it does not, the lease will be issued. These regulations only define and specify how the value of the deposit under application shall be determined; the regulations do not alter the intent or operation of the applicability of Section 9 of the Mineral Leasing Law (30 U.S.C. 211(b)), or the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351359) as they relate to the issuance of prospecting permits and subsequent preferential rights to lease.

Competitive lease applications are filed with the BLM State office, which reviews the applications and refers them to the USGS for a mineral classification report, setting rentals and royalties, bonding requirements, and special stipulations on exploration and mining. The USGS may recommend adding or deleting lands to establish a logical mining unit. The application is then referred to the appropriate surface management agency for a technical examination and environmental analysis. The BLM State office then reviews the reports, recommendations and stipulations, and offers the lease for sale. A lease is issued to the highest qualified bidder after receipt of the bonus bid, rental fees, and required bond, and upon agreement of stipulations.

A. PENDING APPLICATIONS

1. PROSPECTING PERMITS

Applications for 98 prospecting permits involving 121,037 acres are pending for the study region. The applications are here divided into nine geographic groups (Map 2). Applicants and acreages are:

Serial No.	Applicant	Acreage
	CHESTERFIELD-RESERVOIR MOUNTAIN AREA	
I-9333, 9334	Karla R. Aden	2640
I-3820	Elizabeth B. Archer	320
I-9318	Gilbert E. Fowler	1200
	WOOLEY-GRAYS RANGE AREA	
I-9332, 9335--9339	Karla R. Aden	4251
I-4423	John D. Archer	80
I-4900	FMC Corporation	120
I-9319	Gilbert E. Fowler	2440
I-9347--9349	Christian F. Murer	5840
I-8128, 8129	National Steel Corporation	4429
I-8150, 8151	Richards & Associates	4602
	ASPEN RANGE AREA	
I-9338, 9341	Karla R. Aden	1120
I-3725, 4393,) 4768, 4859)	Elizabeth B. Archer	761
I-2544, 3773, 3778,) 4394, 4878, 5862,) 7411)	John D. Archer	1000
I-8107, 8108,) 8111, 8112)	Earth Sciences, Inc.	4121
I-9320, 9321, 9326	Gilbert E. Fowler	7356
I-9349--9351, 9354	Christian F. Murer	6742
I-8127	National Steel Corporation	1960
I-8144, 8146	Richards & Associates	2948
I-9286, 9287, 9289	Philip Shaiman	5350
I-9129	J. R. Simplot	20
	SCHMID RIDGE AREA	
I-3777, 4975,) 6274, 6295)	Elizabeth B. Archer	1440
I-7058, 7059	Cominco American	2160
I-8111, 8113	Earth Sciences, Inc.	4812
I-3798	FMC Corporation	440
I-9322, 9325	Gilbert E. Fowler	1418
I-8131	National Steel Corporation	2526
I-8147, 8149	Richards & Associates	4043

Serial No.	Applicant	Acreage
DRY RIDGE AREA		
I-9331, 9339, 9343	Karla R. Aden	2404
I-9322, 9323, 9327	Gilbert E. Fowler	2211
I-9353, 9358	Christian F. Murer	1036
I-8130	National Steel Corporation	2444
I-8143, 8148	Richards & Associates	4820
WEBSTER RANGE NORTH AREA		
I-9331	Karla R. Aden	80
I-4294, 5086	Elizabeth B. Archer	292
I-3715	John D. Archer	353
I-8114	Earth Sciences, Inc.	2523
I-9352	Christian F. Murer	80
I-8145	Richards & Associates	2188
WEBSTER RANGE SOUTH AREA		
I-9331, 9340, 9342	Karla R. Aden	2641
I-4339	John D. Archer	120
I-8109, 8110	Earth Sciences, Inc.	5119
I-9324, 9327--9329	Gilbert E. Fowler	3962
I-9352, 9355, 9356	Christian F. Murer	4400
I-8132--8134	National Steel Corporation	7303
I-9192	Nuclear Dynamics	1076
I-8145	Richards & Associates	320
MONTPELIER CANYON AREA		
I-9344	Karla R. Aden	801
I-9330	Gilbert E. Fowler	1204
OVID-BLOOMINGTON AREA		
I-9345, 9346	Karla R. Aden	600
I-9357	Christian F. Murer	720
I-4387	Eldon Young	200

2. PREFERENCE-RIGHT LEASES

Applications for four preference right leases involving 2605 acres are pending for the study region (fig. 2-1). They are discussed with the prospecting permits: East Fort Hall with Area A, the other three with Area B.

Lease no.	Applicant	Acreage	Location
I-179	FMC Corporation	492	East Fort Hall
I-015939	FMC Corporation	1232	Wilson Ridge
I-2023	Monsanto Co.	720	Pelican Ridge
I-2530	Monsanto Co.	160	Henry North

3. COMPETITIVE LEASES

Applications for three competitive leases involving 4280 acres are pending for the study region (fig. 2-2). They are discussed with the prospecting permits: Dairy Syncline with Area D, North End Dry Ridge with Area E, and Crow Creek with Area G.

Lease no.	Applicant	Acreage	Location
I-8289	Beker Industries, Inc.	760	North End Dry Ridge
I-8636	Beker Industries, Inc.	1400	Dairy Syncline
I-8933	Beker Industries, Inc.	1200	Crow Creek

4. FRINGE ACREAGES

Applications for four fringe acreages involving 2150 acres are pending for the study region.

Lease no.	Applicant	Acreage	Associated activity
I-014914 and I-014959	Alumet Group	650	Diamond Creek
I-014958 and I-016179	Alumet Group	880	Swan Lake Gulch
I-04	Beker Industries, Inc.	560	Maybe Canyon
I-04494	J. R. Simplot Co.	60	Conda Mine

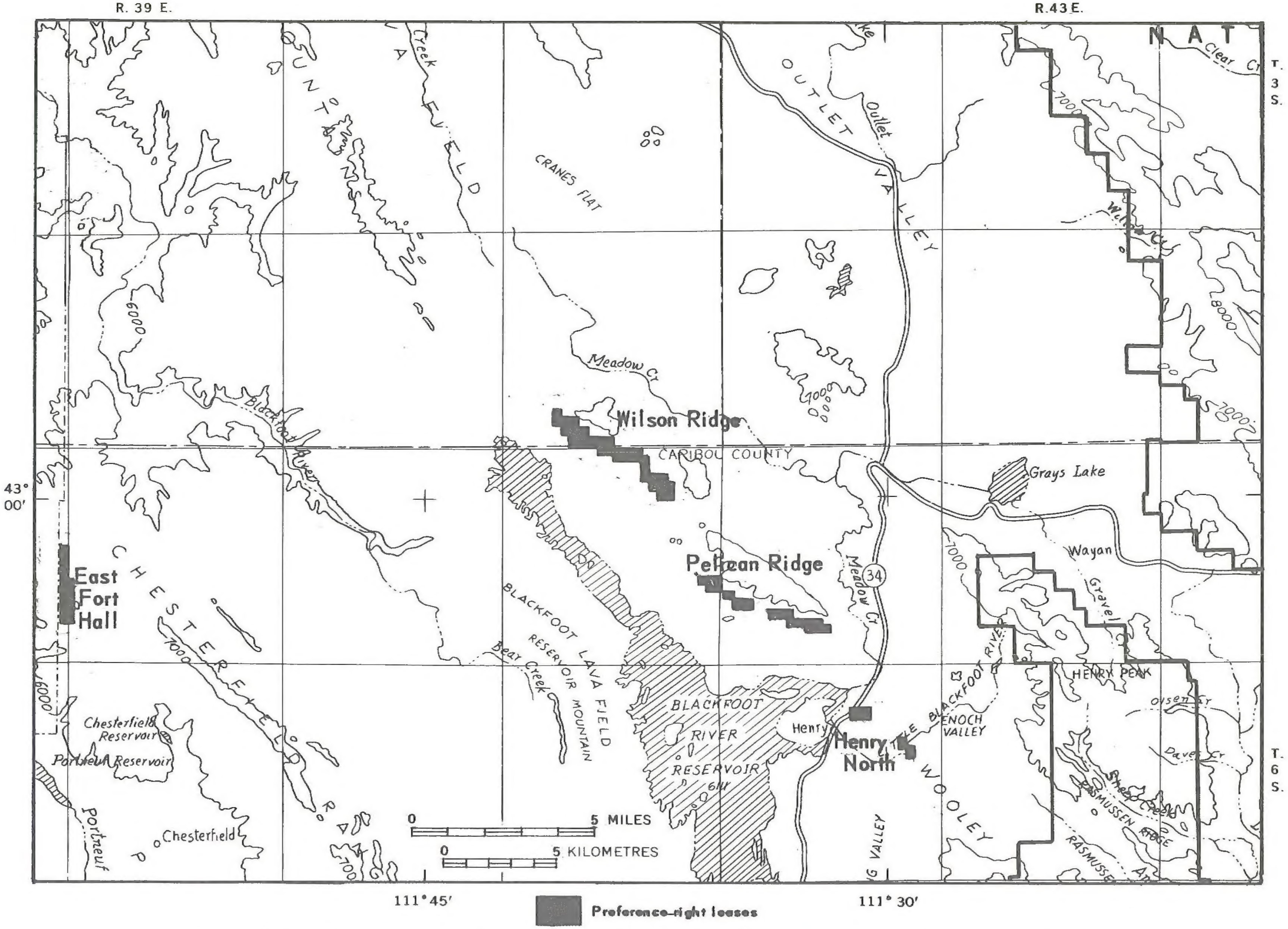

Figure 2-1.-- Preference - right leases applied for, East Fort Hall, Pelican and Wilson Ridges, and Henry North Continuation lease areas.

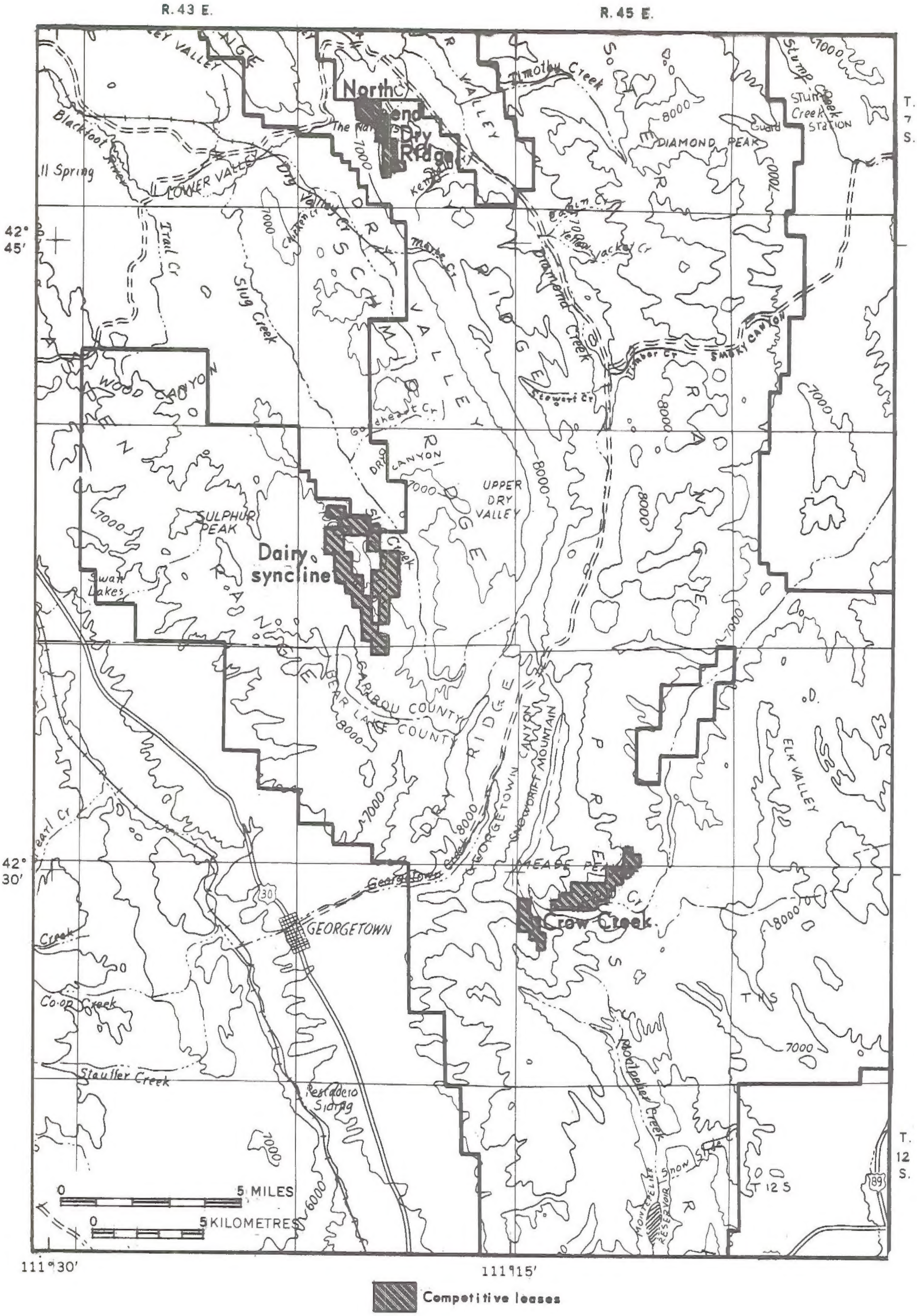

Figure 2- 2-- Competitive leases applied for, north end Dry Ridge, Dairy syncline, and Crow Creek areas.

The Beker Industries, Inc. application consists of 280 acres next to the proposed South Maybe Canyon mine (Part 5.1) and 280 acres next to the present North Maybe Canyon mine. The J. R. Simplot Co. application adjoins the Woodall Mountain unit of the presently-operating Conda mine. The Alumet Group applications adjoin leases covering the Diamond Creek and Swan Lake Gulch mining plans (Part 4).

5. TWENTY-YEAR READJUSTMENT OF LEASES

Twenty-nine leases on 11,532 acres in the study region are 20 or more years old and are thus subject to readjustment of terms and conditions, as provided by the Mineral Leasing Act of 1920.

Lease no.	Lessee	Acreage	Lease name
	CHESTERFIELD-RESERVOIR MOUNTAIN AREA		
Bl 056192	Monsanto	65	Chesterfield
I 01005	Monsanto	200	New Chesterfield
I 05860	Monsanto	120	Finch
	WOOLEY-GRAYS RANGE AREA		
I 016	Monsanto	160	Blackfoot Reservoir
I 0997	Monsanto	671	Blackfoot Reservoir
Bl 055875	Monsanto	281	Ballard
I 05723	Monsanto	669	Ballard
I 02272	FMC	80	Blackfoot Reservoir
I 05975	FMC	621	Rasmussen Valley
I 04375	Stauffer	800	Rasmussen Ridge
I 04373	Stauffer	428	Little Long Valley
I 04374	Stauffer	520	Wooley Valley
I 04775	Stauffer	440	Wooley Valley
	ASPEN RANGE AREA		
I 01	Monsanto	200	F & K Syncline
I 03	Monsanto	161	Johnson Creek
I 0257	Monsanto	120	Little Gem
I 05613	Monsanto	520	Blackfoot Bridge
I 01603	Simplot	688	Middle-South Sulphur Canyon
I 04494	Simplot	467	Conda Mine

		DRY RIDGE AREA	
I 04	Beker Industries, Inc.	1522	Maybe Canyon
		WEBSTER RANGE SOUTH AREA	
I 01440	Monsanto	1080	Wells Canyon
I 01441	Monsanto	438	Wells Canyon
		BLACKFOOT MOUNTAINS AREA	
Bl 055163	Simplot	160	Wolverine

B. POTENTIAL EXPLORATION

1. PROSPECTING PERMITS

Prospecting permits allow exploration on the permit lands. The permit states that the permittee shall diligently prospect the lands by core drilling or other acceptable methods. Prospecting is required either to extend the time period of the permit or to qualify for a preference-right lease. Special stipulations to the permit require:

1. A prospecting plan must be approved in advance by the USGS.

2. To qualify for an extension, the permittee must drill a minimum number of adequate test holes (usually 2 to 4) during the initial term of the permit at a location and depth approved by the Geological Survey, or other comparable prospecting must be performed.

3. To qualify for a preference-right lease for all or part of the land, a permittee must drill a minimum number of adequate test holes (usually one hole for each 40-acre subdivision) or perform comparable prospecting in accordance with the approved plan for exploration and discover a valuable, phosphate deposit satisfactory to the USGS.

The amount of exploration that might result if the pending permit applications are approved is difficult to estimate. Realistically, the amount of land made available for prospecting will be substantially reduced after title reports, mineral classifications, technical examinations, and environmental analyses are completed. Perhaps the best guide to what may result are the past records. In Idaho, between 1963 and 1970, phosphate permit applications were filed on 174,000 acres of land; permits were issued on 76,000 acres. Preference-right leases were issued on 9,500 acres with another 2,500 acres currently pending.

With this as a base, of the 121,037 acres now under application, permits could be expected on about 53,000 acres. About 160 test holes would be made during the initial two-year period. An additional 200 test holes would be make on the 8,500 acres that may qualify for preference-right leases.

Obviously, the best prospecting target areas were explored prior to 1970. Much of the land now under application involves deep-seated (over 2,000 feet) phosphate beds, so the amount of surface exploration will probably be substantially less.

In general, exploration is done to determine quality, quantity, and workability of the ore. Correlation of geologic sections revealed by trenching and drilling is necessary to estimate reserves and to design mining pits and panels. Conventional exploration methods include core drilling and surface trenching of outcrop or near-surface exposures. These methods are now being supplemented by geochemical and geophysical methods. Geochemical analyses of vegetation and electric or gamma-ray neutron logging of drill holes yield supplemental information about concentrations of ore.

Topography generally dictates equipment requirements. Steep drill sites normally require "pioneer" access roads and drill site preparation by a bulldozer or grader; level areas can be explored by cross-country travel of a drill mounted on skids, tracks, or rubber tires. Rotary coring drills were generally used until recently; they used water or other fluid as a drilling medium and thus required the excavation of a mud pit. Now, however, "duo-tube" rotary drilling equipment uses air under pressure to flush the drill cuttings to the surface.

Exploratory holes in the study region do not normally exceed 6 inches in diameter and until recently have rarely exceeded 500 feet in depth, with most holes 200 to 500 feet deep. Blast-hole drill equipment has been used in several instances. Because of increased demands for phosphate ore, decreased availability, increased prices, and advances in drilling technology, proposed drilling depths have increased drastically. Proposals now include both shallow holes and holes 1000 to 1500 feet deep.

Trenching is usually done by a bulldozer with cuts made perpendicular to the surface exposure of phosphate ore. The trench is begun next to the exposure, crosses the exposure, and ends a short distance beyond it. The fresh cut shows bedding attitude and structure, grade of ore, contact zones, etc. The newly exposed ore is sampled for analysis. Bulk samples may be taken for use in pilot plants.

2. PREFERENCE-RIGHT LEASES

Preference-right leases are issued when the USGS has certified the discovery of a valuable, phosphate deposit and sufficient prospecting has been done. Additional exploration of the leaseholds would be at the option of the lessee, subject to approval of exploration or mining plans by the USGS and concurrence of the surface management agency. Special stipulations may be imposed on the leases to minimize adverse environmental impacts.

The mining companies indicate that no mining is likely on the Wilson Ridge, East Fort Hall, or Pelican Ridge properties over the next 25 years. The Henry North Area is part of Monsanto Company's proposed development of the Henry North Continuation, which is described in Part 7.

Mining of any of the four pending leases would be by conventional surface mining methods as described in Part 1.

3. COMPETITIVE LEASES

Even though applicants gain no advantages by filing competitive lease applications, such requests indicate an interest in obtaining the right to mine particular deposits. Present laws and regulations impose no requirement as to when exploration, development or mining must begin on the leaseholds.

The degree of exploration or development will depend largely on what companies or individuals obtain the leases. Someone not operating in the region or an in-region operator with limited reserves might plan early development. On the other hand, an in-region operator with substantial mineral reserves might delay development for many years. For the purpose of this study, it is assumed that the leases will be offered and exploration and development will proceed within the next two decades.

As the applications involve lands containing outcrop or near-surface exposures of phosphate, it is assumed that the deposits will be trenched and drilled by standard exploratory methods and that the deposits will be mined by conventional surface mining methods as described in Part 1.

4. FRINGE ACREAGES

All of the pending fringe-acreage applications are tied to ongoing mines or to the mining plan proposals addressed in Parts 4, and 5. This study assumes that all the fringe acreage lands will be approved and mined by conventional surface methods.

5. READJUSTMENT OF LEASES

Stipulations providing for protection of non-mineral resources and the environment will be imposed in the twenty-year readjustments. Environmental analysis reports will be required before new terms and conditions are proposed and before mining and reclamation plans for the leases are approved. Mine plans have been proposed for nine of these leases: Beker Industries' South Maybe Canyon and Champ mines, FMC Corporation's Dry Valley mine, Monsanto Company's Caldwell Canyon and Blackfoot Bridge mines, Simplot Company's North Trail Canyon and Middle Sulphur Canyon mine, and Stauffer Chemical Company's Wooley Valley Unit 3 and Rasmussen Ridge mines (Parts 5, 7, 9, 10, and 11). It is assumed that the other 20 leases will not be mined before the year 2000.

CHAPTER II
DESCRIPTION OF THE EXISTING ENVIRONMENT

The permit applications, leases, and readjustments involve lands throughout the study region, but most of them are near proposed mines. Since Part 1 describes the region and Parts 4 to 11 describe the area around each proposed mine, this part focuses on aspects of the permit and lease areas that are significantly different from those of the region. Thus climate, water quality, air quality, vegetation, agriculture and range, and socioeconomic development are not discussed again here. The permit and lease areas differ from areas with active and proposed mines in that they are generally higher and more rugged and remote.

Landtype associations are briefly discussed for each area; Part 1 describes each association and shows its distribution through the study region. Part 3 discusses present and proposed transportation networks, so only aspects of transportation peculiar to each permit or lease area are discussed in this part. Aesthetics are also discussed for each area.

Prospecting and leasing will extend into the Salt, Portneuf, and Bear River basins, in addition to the basins affected by the proposed mines.

There has been no systematic archeologic study of the permit and lease areas, but regional surveys indicate the likelihood of scattered sites throughout the areas.

A. CHESTERFIELD AND RESERVOIR MOUNTAIN PERMIT AREAS: EAST FORT HALL LEASE AREA

Most of this area lies south of the Blackfoot River between the Blackfoot River Reservoir and the Fort Hall Indian Reservation (fig. 2-3). It includes most of the Chesterfield Range and Reservoir Mountain.

The Chesterfield Range is the dominant physiographic feature of the area. It is a broad northwest-trending range bounded on the southwest by Portneuf Valley and on the northeast by the valley of Corral Creek and the Blackfoot River. Maximum elevation of the range is 7,260 feet, and the relief between the top of the range and Portneuf Reservoir is 1,900 feet. Drainage is via the Portneuf River to the south and the Blackfoot River to the north.

Reservoir Mountain is about 5.5 miles long and 2.5 miles wide. It is nearly surrounded by the Blackfoot Lava Field. The major drainage is westward and northward via Corral Creek into the Blackfoot River. The highest point of the mountain is 7,143 feet, and the maximum relief above the valley of Corral Creek is thus about 1,000 feet.

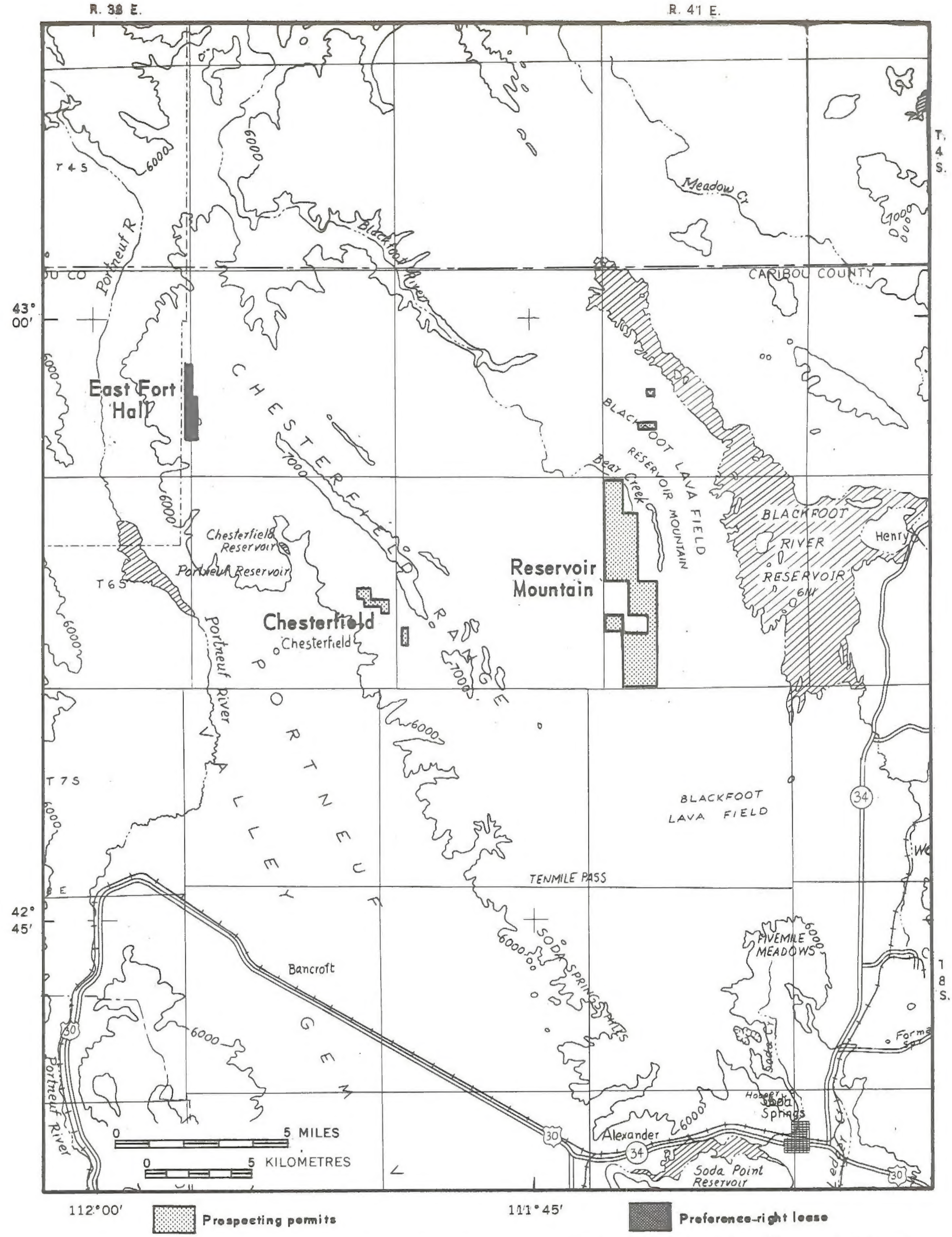

Figure 2-3.-- Prospecting permits and preference - right lease applied for, Chesterfield and Reservoir Mountain permit areas and East Fort Hall lease area.

Much of the Chesterfield Range is covered by the Salt Lake Formation of Tertiary age, and basalt of Quaternary age surrounds much of Reservoir Mountain. Widespread tufa deposits occur along the southwestern flank of Reservoir Mountain near some Phosphoria outcrops, and carbon dioxide-charged springs occur in the southern part of the tufa outcrop.

Northwest-trending folds and faults are the major structures of the area. A transverse fault of significant displacement occurs near the southern end of Reservoir Mountain. The Phosphoria Formation is exposed along the limbs of the folds. Faults cut out some parts of the Phosphoria, and the Salt Lake sediments unconformably cover other parts. The Phosphoria also occurs at depth beneath widespread exposures of Triassic units. All of the rock units exposed at the surface in the area are probably part of one or more thrust plates. The Phosphoria may also be present beneath these thrust(s), but too little information is available to assess these resources.

The ore zones total about 39 feet in weathered rock and are estimated to be about 35 feet thick in fresh rock. A minimum estimate of the resources of the area is about 4 billion short tons of ore-grade rock. It is considered a minimum because the extent of the Meade Peak beneath large areas covered by the Salt Lake Formation and basalt cannot be estimated with available data. Of the estimated resources, about 1 billion short tons underlie Phosphoria outcrop, another 1 billion short tons occur at depths less than 2,000 feet beneath Triassic and younger units, and the rest is at greater depths--down to about 5,700 feet in the Reservoir Mountain syncline.

Because this area is entirely outside the Caribou National Forest, it is not part of the region for which Garrand calculated reserves of phosphate rock for the U.S. Forest Service. In that region, however, the relation of the reserves calculated by Garrand to the total resources underlying Phosphoria outcrop ranges from 10 to 19 percent and averages 15 percent. Assuming that that average is applicable to this area, the reserves are 15 percent of about 1 billion short tons of resources, that is, 150 million short tons of ore-grade rock. None of the reserves have been mined, and no mines are proposed in this area.

FMC Corporation has applied for a preference-right lease, I-179, for property in the western part of the Chesterfield Range and along the boundary of the Fort Hall Indian Reservation. The site includes Phosphoria outcrops that occur in subsidiary folds of the Rock Creek syncline. Several faults complicate the distribution of the Phosphoria rocks.

Landtype association 19 covers about half of the Reservoir mountain area; it has high erosion potential and very high slump potential. Association 7 covers most of the remaining area; it has high slump and erosion potential.

The Reservoir mountain area includes the headwaters of Bear Creek and of several perennial tributaries to Corral Creek. Perched aquifers may occur in much of the area in gravels of the Salt Lake Formation. Aquifers of the Dinwoody Formation underlie most of the Reservoir Mountain area. The basalts of the Blackfoot Lava Field underlie small parts of the Reservoir Mountain area; they are probably very permeable, and the water table is shallow. Drilling east of Corral Creek (Lease 013215) has tapped flowing waters charged with carbon dioxide; they may occur elsewhere in the area.

The main surface ownership in the area is State, followed by private; very little is Federal. Most applications flank Phosphoria outcrops.

The operating Gay Mine is about 15 miles northwest of the area, but there has been no mining in the area itself, and no mine plans are proposed.

Access is by utility roads.

This area includes a critical deer winter range and migration corridors from higher elevations in to the lower Chesterfield Mountain area. Excellent browse and forb communities support high populations of sage, sharptail, and forest grouse. Elk, bear, and moose are present during portions of the year. Several predator species are associated with the area as are amphibians and reptiles. The Reservoir Mountain area is an important wintering area for peregrine falcon, bald eagle, American rough-legged hawk, merlin, and golden eagle. Important waterfowl and sandhill crane habitat supports high populations of these species. The streams within the area contain low fish population and produce very little fishing.

However the nearby Blackfoot River, Chesterfield and Portneuf reservoirs provide a great deal of quality fishing opportunities as well as picnicking and camping use. Much of this use occurs from visitors outside the study area. Hunting, snowmobiling and other dispersed recreation uses are more of a local nature.

Populations of grouse waterfowl and big game provide high bird hunting and moderate big game hunting opportunities.

The visual variety for the area is rated minimal. Land features are of low quality. Part of the area is in the middleground viewing zone from Chesterfield and the background viewing zone from U.S. Highway 30N.

B. WOOLEY AND GRAYS RANGES PERMIT AREAS: PELICAN AND WILSON RIDGES AND HENRY NORTH CONTINUATION LEASE AREAS

This area includes northwest-trending ranges north and east of the Blackfoot River and the Blackfoot River Reservoir (fig. 2-4). The

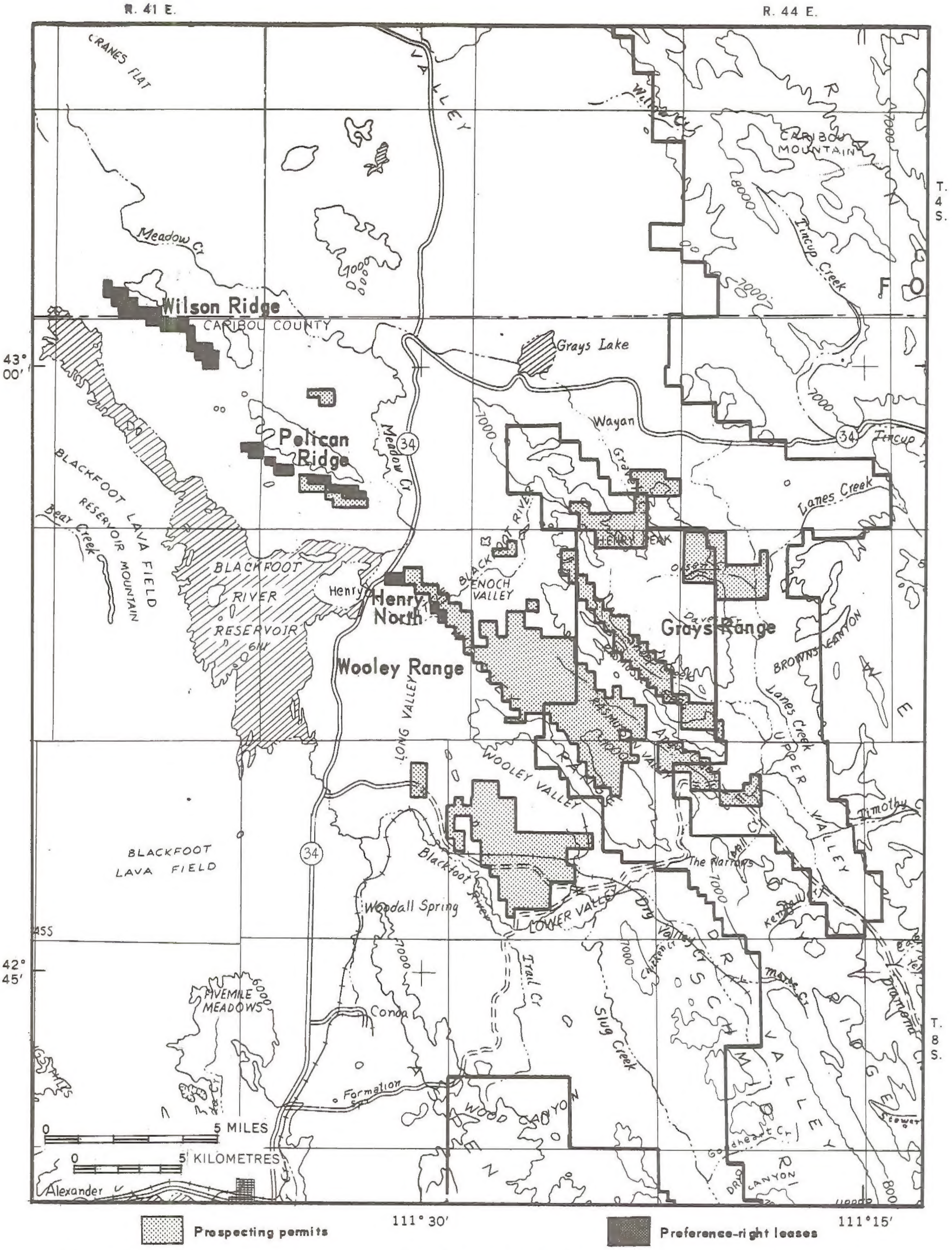

Figure 2-4.-- Prospecting permits and preference-right leases applied for, Wooley and Grays Ranges permit areas and Pelican and Wilson Ridges and Henry North Continuation lease areas.

Blackfoot Mountains extend into the northwest corner of the area. Little Gray, Pelican, and Wilson Ridges and Grays Range mark the general northern and eastern margins of the area. Other ranges in the area are Wooley Range, Rasmussen Ridge, and the Fox Hills. Henry Peak at 8,320 feet in Grays Range is the highest point in the area; it is about 2,200 feet above the Blackfoot River Reservoir.

Grays Range is the largest in the area, about 14 miles long and up to about 5 miles wide. Upper Valley borders the range on the southeast, and the broad valley of Grays Lake borders it on the northeast. Most of the range drains via Sheep and Lanes Creeks into the Blackfoot River. The northern part of the range drains via Gravel Creek into Grays Lake.

Wooley Range occupies the central part of the area and is about 10 miles long and about 2 miles wide. Maximum elevations are about 7,900 feet in the southern part of the range, and relief with Rasmussen Valley to the east is about 1,500 feet. The northern part of the range is bounded on the east by Enoch Valley. Long Valley and Wooley Valley are contiguous along the west side of the range. The southern part of Wooley Range is drained by Angus Creek and other small tributaries of the Blackfoot River; the northern part is drained by the Little Blackfoot River.

The southwest flanks of Wilson and Pelican Ridges drain via small streams directly into the Blackfoot River Reservoir. Drainage on the northeastern side is via Meadow Creek, which also enters the reservoir. The Blackfoot Mountains drain into the Blackfoot River and Reservoir.

Major structures of the area are northwest-trending anticlines and synclines, normal and reverse faults that parallel the folds, and a few transverse faults that offset the folds. Although some parts of the area are structurally complex, some of the main structures extend through and beyond the area.

Most of the Phosphoria crops out in the central part of the area along the limbs of the Georgetown Syncline and the west limb of the Lanes Butte Syncline, but about 4 miles crop out in the northwest corner of the area. A small outcrop occurs farther northwest on the faulted east limb of the Georgetown Syncline along the front of Pelican Ridge. Other small outcrops are farther northwest on both faulted limbs of the Snowdrift Anticline along Wilson Ridge, west of the Blackfoot River Reservoir outlet, in several fault segments in the northern part of Grays Range, and east of the range in the northern end of Upper Valley. Additional small outcrops occur in the southern part of the area in the complex structure of the Fox Hills, in the north end of the Schmid Syncline near the Blackfoot River, and in a little fault wedge north of The Narrows. The Phosphoria is also present beneath exposures of Triassic and younger units throughout the area. All of the rock units exposed at the surface in the area are interpreted to be above large thrusts. The Phosphoria may also occur beneath the thrusts, but lack of knowledge precludes attempts to assess the phosphate resources there.

The ore zones total about 46 feet thick in weathered rock and are estimated to be about 41 feet thick in fresh rock. The total resources of the whole area are about 12 billion short tons of phosphate rock. Of this amount about 1 billion short tons underlie Phosphoria outcrop, about 5 billion short tons occur at depths less than 2,000 feet beneath Triassic and younger units, and the rest is at greater depths--down to about 6,600 feet in the central part of the Lanes Butte Syncline.

The phosphate reserves calculated by Garrand are about 160 million short tons of phosphate rock (not including the resources of Wilson Ridge or the Blackfoot Mountains) and make up about 19 percent of the resources that underlie Phosphoria outcrops. Past production from the Ballard, Henry, and Wooley Valley mines amounts to about 23 million short tons. Future production from the on-going Henry and Wooley Valley mines is estimated at about 14 million short tons, and production from proposed mines (N. Henry Continuation, Wooley Valley No. 3, and Rasmussen Ridge) is expected to be about 24 million short tons. The total, therefore, that has been mined and is expected to be mined is about 61 million short tons. This leaves about 100 million short tons of reserves in the main part of the area.

There are two preference-right lease applications for sites in the Wooley-Grays Ranges area. One is by FMC Corp., I-015939, for property along the south front of Wilson Ridge, which includes 2 small outcrops of Phosphoria. The Enoch Valley Fault bounds the front of the ridge and appears to have cut out much of the Phosphoria; outcrops are probably cut off by the fault a short distance down dip. Springs occur along the fault in the western part and have deposited tufa over a large area extending from the ridge front to Blackfoot Reservoir, into which they drain. The other preference-right lease application, I-2023, is by Monsanto Company for property along the south flank of Pelican Ridge. The ridge front here is also bounded by the Enoch Valley Fault, and most of the Phosphoria appears to be cut out by the fault: only one small outcrop is present along the ridge front. The single Phosphoria outcrop is also likely to extend only a short distance downdip before being cut off by the fault.

Landtype associations 2 and 4 cover nearly half of the area, and associations 1, 3, 8, 11, and 19 cover the rest. About one-third of the area has high erosion and slump potential.

The Henry North area lies north of the Little Blackfoot River, and the south and southwest parts of the area straddle or border the Blackfoot River. The area includes Angus, Gravel, Lanes, and Sheep Creeks; all are perennial. Similarly, the Pelican Ridge area has two perennial streams, and part of it drains into Pelican Slough. Several springs feed perennial streams on the west flank of Wilson Ridge and along Lanes Creek. Alluvium-filled valleys, such as the Enoch-Little Blackfoot, Rasmussen, and Meadow Creek Valleys, probably have shallow water tables.

The area includes and adjoins important summer and winter range for deer, elk, and moose. Seasonal elk migration routes cross the southern part of this area. Many of the big game that utilize the central part of the study area migrate through this part of the range. It is estimated the area contains 125 elk, 35 moose, and several black bears. Large numbers of forest grouse are present and this area provides some of the better forest grouse hunting within the study area. Important habitat is present for waterfowl, greater sandhill crane, and a potential for whooping cranes. The Blackfoot River, Angus Creek, Lanes Creek, and the Little Blackfoot River are the major streams present that support excellent fish populations and receive high fishing pressure. Lanes Creek and tributaries provide excellent spawning and rearing areas for migrating cutthroat trout from the Blackfoot River and Reservoir system. Likewise, Angus Creek is rated excellent, although its headwaters have somewhat been degraded by mining and by livestock. It contains cutthroat trout, sucker, dace, redside schiner, and sculpin. The Blackfoot River Reservoir is rated excellent despite streamside damage from livestock. It supports rainbow, cutthroat and brown trout, sucker, dace, redside schiner, carp, and sculpin. The Little Blackfoot River has good fishing only near the reservoir.

Surface ownership for the permit areas is mainly private and National Forest, with subordinate State and only a few percent National Resource Lands. Most applications are downdip from Phosphoria outcrops.

Inactive mines in the area are Monsanto's Ballard mine and Stauffer's Wooley Valley Unit 1 mine. Present mines are Monsanto's Henry mine and Stauffer's Wooley Valley Units 2 and 4 mines. Proposed mines are Monsanto's Henry North Continuation (Part 9) and Stauffer's Wooley Valley Unit 3 (Part 11) and Rasmussen Ridge (Part 11) mines.

Access is by State Highway 34, and several secondary and utility roads. The present rail spur to the Wooley Valley mine crosses the southwest corner of the area, and the proposed Long-Angus-Rasmussen Valley spur would extend into the southeast corner.

Highway 34 which has potential as an important access route to Yellowstone National Park from the south provides important recreation access and opportunities for viewing landscape and wildlife. The Blackfoot River Reservoir and several area streams provide important fishing resources which receive heavy recreational use. Grays Lake National Wildlife Refuge provides viewing opportunities for numerous bird species including the rare whooping crane. Deer, elk and upland bird and water fowl hunting is popular and is increasing. Snowmobile and off-road vehicle activity as well as dispersed recreation such as camping and picnicking is receiving moderate levels of use.

The visual variety of the area is rated minimal in the southwest one-third and common in the remaining two-thirds. Land features are of moderate quality. The area is in the foreground and middleground viewing zones of secondary roads, and the northwest parts are in the middleground zone of the Blackfoot River Reservoir.

C. ASPEN RANGE PERMIT AREA

The Aspen Range area extends from the Blackfoot River about 20 miles south to the vicinity of Big Canyon Creek (fig. 2-5). Slug Creek Valley lies to the east, and the Blackfoot Lava Field and Bear River valley lie to the west. The area includes the divide between Great Basin and Columbia River drainage. The highest point in the area is 8355 ft., about 2500 ft. above Bear River valley. The terrain is generally rugged.

The dominant structure is the north-plunging Trail Creek syncline. The east limb of the syncline has been cut off by normal faults, and stratigraphic units and folds are truncated throughout much of the area by closely spaced faults many of which, however, have only small displacements. Large normal faults bound the Aspen Range on the west. Overturned beds are common along the range front.

The Phosphoria Formation is exposed on the west limb and around the nose of the Trail Creek syncline, and it extends beneath the surface in the central part of the syncline. The Phosphoria is not exposed in the east limb of the syncline owing to faulting, but it crops out in large areas of contiguous fault blocks. Elsewhere it is widely exposed in small fault blocks and folds; it also occurs at depth beneath exposures of Triassic and younger units, for example, beneath Triassic units exposed in the hills along the east side of the graben of Bear River Valley.

All of the units exposed at the surface are in the upper plate of the large Meade thrust. The Phosphoria probably occurs as well beneath the thrusts, but its character and distribution are not known.

The ore zones total about 32 feet thick in weathered rock and about 30 feet thick in fresh rock. The total resources for the area comprise about 5 billion tons of ore-grade rock. Of this amount, about 900 million tons underlie Phosphoria outcrop; the rest underlies Triassic and younger units. The central part of the Trail Creek syncline contains about 2.5 billion short tons of ore-grade rock, about 35 percent of it at depths less than 2000 feet. The top of the ore is deepest in the northern part of the syncline--about 4800 feet.

The phosphate reserves calculated by Garrand are about 170 million tons, nearly 20 percent of the total underlying Phosphoria outcrop. Of this amount, about 10 million tons have already been mined from open pits of the Conda mine complex. Alumet's proposed Swan Lake Gulch mine is expected to produce 57 million short tons; Simplot's proposed North Trail and Middle Sulphur Canyon mines, 6 million tons; and Monsanto's proposed Trail Creek mine, 30 million tons. The total amount of ore, therefore, that has been produced or is proposed for production is 105 million short tons. This leaves about 70 million short tons of reserves.

Landtype associations 3 and 4 cover about half of the area; association 19 dominates the rest, with subordinate areas of 1, 6, 7,

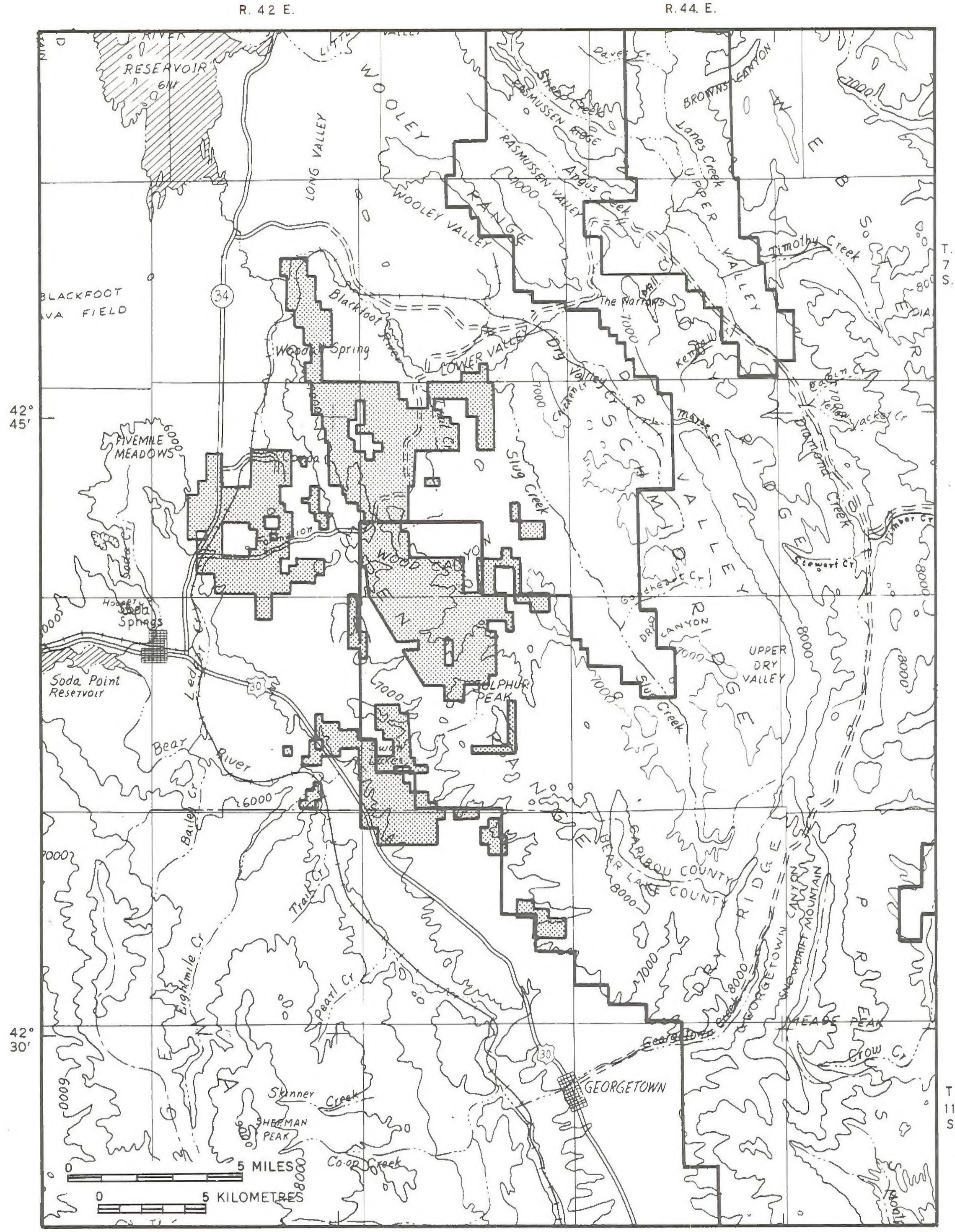

Figure 2-5.-- Prospecting permits applied for, Aspen Range permit area.

and 11. Nearly all of the area has high erosion or slump potential, and much of it has steep slopes.

Johnson, Slug, and Trail Creeks in the northern and eastern parts of the area flow into the Blackfoot and Columbia River systems. Streams in the western and southern parts flow into the Bear River and Great Basin Drainage systems.

Water tables are probably shallow in the valleys of Johnson, Slug, and Trail Creeks. Much of the Aspen Range is underlain by aquifers of the Dinwoody Formation. Gravels of the Salt Lake Formation in the benches west of the range probably include perched aquifers. The lowlands east of Soda Springs are underlain by permeable basalts, and the water table is shallow. Widespread tufa deposits just west of the Aspen Range indicate ground waters heavily charged with carbonate. Carbon-dioxide-charged springs are common a mile or so west of the area. Springs in lower Sulphur Canyon contain elemental sulfur.

Most of the west part of the area is critical deer winter range, and part of it adjoins critical elk winter range. It is estimated the area can support 125 wintering elk and 1,000 wintering deer. Peregrine falcons have been sighted within this area. The riparian and marshy habitat supports high populations of beaver in Trail Creek, Johnson Creek and Slug Creek. Important nesting habitat for waterfowl and greater sandhill crane is present. Excellent habitat is present for the whooping crane. Deer and elk migration routes cross the southwest part. Most of the area has no fisheries. Swan Lake is rated good as a fishery and is stocked annually with rainbow trout. Swan Reservoir contains sucker, but it is marshy and only a few feet deep. Slug Creek is rated very good despite local damage by livestock. It contains cutthroat and brook trout, sucker, dace, and sculpin.

Surface ownership is mainly private and National Forest, with very subordinate State and National Resource Lands. Most of the applications are downdip from Phosphoria outcrops. The area includes Stauffer's inactive Diamond Gulch mine and both active and inactive parts of Simplot's (formerly Anaconda's) Conda mine. Proposed mines are Alumet's Swan Lake Gulch mine (Part 4), Monsanto's Trail Creek (Part 9) and Blackfoot Bridge (Part 9) mines, and Simplot's North Trail Canyon (Part 10) and Middle Sulphur Canyon (Part 10) mines.

U. S. Highway 30N passes through the extreme southwest corner of the area. Other access is by secondary and utility roads. The present rail spur cuts through the western part of the area and borders it on the north. The proposed Slug Creek spur would border it on the east.

The close proximity of this area to Soda Springs makes the hunting and fishing resources very popular. U. S. Highway 30, State Highway 34 and the Trail Creek road are important recreation routes and receive heavy use. Driving for pleasure is very popular. Camping, picnicking swimming and viewing natural phenomena receive heavy use at

Swan Lake. The foothill areas receive moderate ORV use. The Huckleberry Basin inventoried roadless area is situated within the north-central portion of the Aspen Range permit area. The 18,500 acre roadless area has not been analyzed by land use planning procedures and is awaiting alternative consideration regarding its wilderness desirability so the resource values can be determined and future management direction set.

Until this determination is complete and made public through the NEPA process, the Forest Service is bound by its agreement with a Federal judge to protect the wilderness values the area may have.

The visual variety is rated minimal for 80 percent of the area and common for the remaining area along Slug Creek. Land features are of moderate to minimal quality. The west flank of the range is in the foreground and middleground viewing zones of U.S. Highway 30N, and the east flank is in the foreground and middleground of secondary roads.

D. SCHMID RIDGE PERMIT AREA AND DAIRY SYNCLINE LEASE AREA

The Schmid Ridge area extends south of the Blackfoot River for about 14 miles (fig. 2-6). It includes Schmid Ridge proper and, in the southwestern part, an area west across Slug Creek Valley from Schmid Ridge. Dry Valley bounds the area on the east. Maximum relief in the area is about 1600 ft.

The dominant structure is the Schmid syncline; the Phosphoria Formation is exposed along the limbs and around the nose of the syncline. Other Phosphoria crops out to the southwest across Slug Creek Valley in the structurally complex Dairy syncline. The Phosphoria is also present beneath exposures of Triassic and younger units throughout the area. All of the rocks exposed at the surface in the area are part of the upper plate of the Meade Thrust. The rock beneath the thrust probably also include the Phosphoria; but too little is known about the character and distribution of the Phosphoria beneath the thrust to assess phosphate resources there.

The ore zones total about 48 feet thick in fresh rock. The total resources of the whole area are about 4 billion short tons. Of this amount about 1 billion short tons underlie Phosphoria outcrop, about 1.5 billion short tons occur at depths less that 2000 feet beneath Triassic and younger units, and the rest is at greater depths down to about 4000 feet in the northern part of the Schmid Syncline.

The phosphate reserves in the area calculated by Garrand are about 120 million short tons of phosphate rock, about 12 percent of the resources underlying Phosphoria outcrops. No significant amount of the reserves has been mined, but Beker's proposed Champ and Mountain Fuel mines are expected to produce about 14 million short tons; FMC's proposed Dry Valley mine is expected to produce 40 million short tons, and Monsanto's proposed Caldwell Canyon mine is expected to produce 12 million short tons. The total amount of ore, therefore, that is proposed

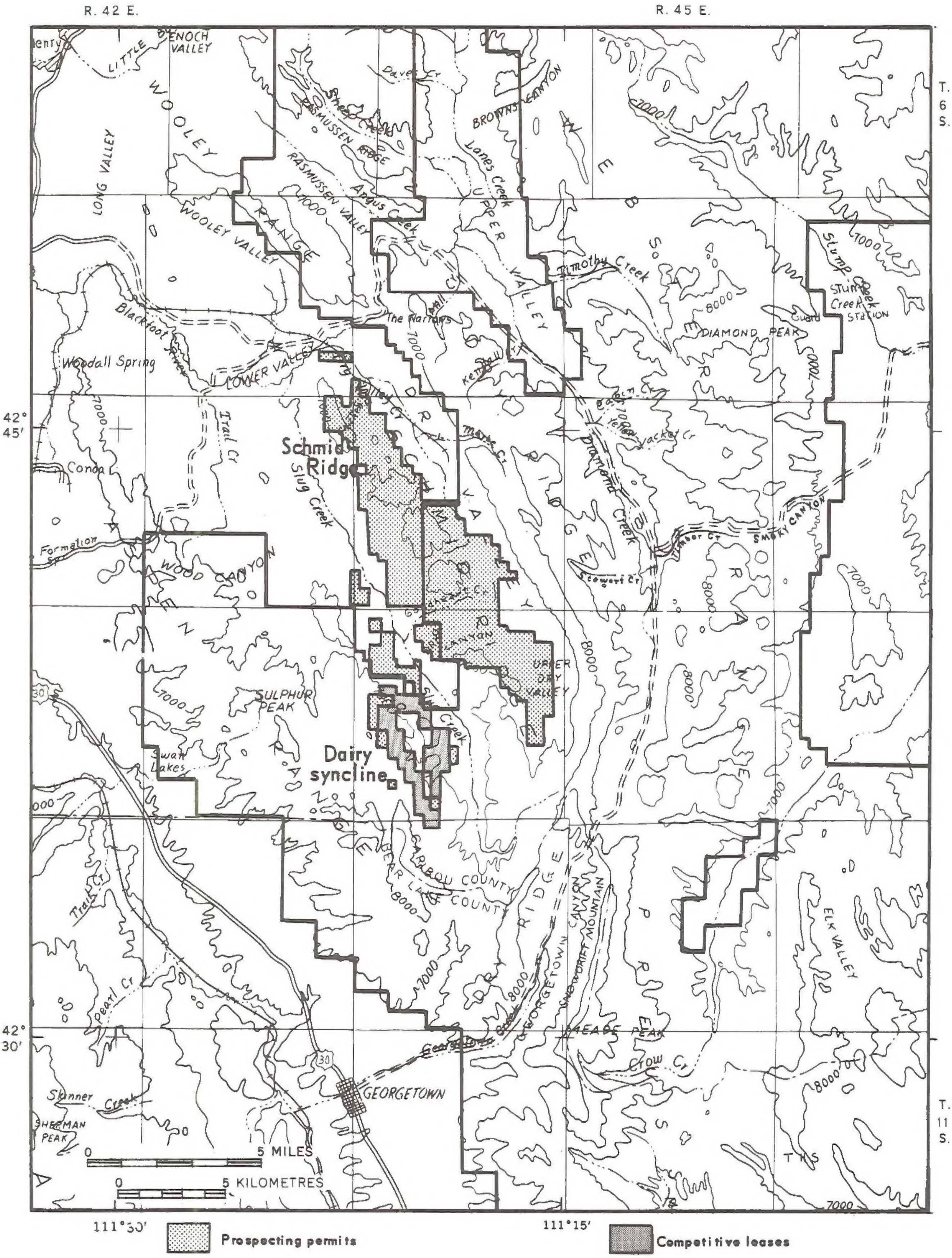

Figure 2-6.--Prospecting permits and competitive leases applied for, Schmid Ridge permit area and Dairy syncline lease area.

for production is 66 million short tons. This leaves about 54 million short tons of reserves.

A competitive lease application, I-8636, has been filed for the area of phosphoria outcrop in the Dairy Syncline in the southwest part of the Schmid Ridge area. The lease area includes several fault blocks and is structurally complex.

Land type association 4 dominates the area, and associations 1, 2, and 3 make up the rest. Most of the area thus has high erosion potential.

The area drains via Dry Valley and Slug Creek into the Blackfoot River. Shallow water tables are likely in Slug Creek and Dry Valleys, although shallow drilling in Dry Valley shows that the permanent water table is at least 20 feet deep. Springs feed perennial streams on the east side of Schmid Ridge and in the valley of Slug Creek. Estimated discharge ranges from a seep to a few tens of gallons per minute. Several wells are mapped in Upper Dry Valley.

The area includes important habitat for greater sandhill cranes and waterfowl in Slug Creek and Dry Valleys and it adjoins additional habitat along the Blackfoot River. Deer, elk, and sage grouse winter throughout the area. Beaver are found on the main stream and tributaries. Elk calving grounds are on Schmid Ridge in the southern part of the area and in Dry Valley just east of the area. Elk migration The area has significant fisheries on Slug Creek.

Big game and upland bird hunting receive moderate recreational use. The low standard roads are used for pleasure driving fishing access and ORV uses. The Huckleberry basin inventoried roadless area is situated within the south central portion of the Schmid Ridge Permit Area. The 18,500 acre roadless area has not yet been analyzed by land use planning procedures and is awaiting alternative consideration regarding its wilderness desirability so that the resource values can be determined and future management direction set.

Until this determination is complete and made public through the NEPA process, the Forest Service is bound by its agreement with a Federal judge to protect the wilderness values the area may have.

Most surface ownership is National Forest, followed by private and National Resource Lands; most applications cover the area between Phosphoria outcrops in Dry Valley and along Slug Creek. There has been no mining in the area. Proposed mines are Beker's Champ (Part 5) and Mountain Fuel (Part 5) mines, FMC's Dry Valley mine (Part 7), and Monsanto's Caldwell Canyon mine (Part 9).

Access is by secondary and utility roads and by railroad in Dry Valley. Extension of the Dry Valley spur is proposed, and another rail spur is proposed for Slug Creek.

The visual variety for the area is rated common. Land features are of low quality. The area is in the foregound and middleground viewing zones of the Dry Valley and Slug Creek roads.

E. DRY RIDGE PERMIT AREA AND NORTH DRY RIDGE LEASE AREA

The Dry Ridge area extends southward about 20 miles from the Blackfoot River in a long narrow arc to Georgetown Creek (fig. 2-7). Dry Ridge is the dominant physiographic feature; it is over 8000 feet high through most of its extent and 9000 feet high at its southern end. The elongate Snowdrift Mountain is east of Dry Ridge across Georgetown Canyon and rises to 9577 feet. Freeman Ridge extends northward from Snowdrift Mountain. The northern half of the area includes only Dry Ridge, which is sharply bounded by Dry Valley and Diamond Creek Valley.

The Georgetown Syncline is the dominant structure of the area. To the north, it is truncated by the Blackfoot fault, to the south by a complex of faults related to the Meade Thrust. The northern part of the east limb also is faulted, and the southern half of the west limb is overturned. Faulting in the area has generally not been severe, although the phosphate rock has been locally cut out by faulting along the west limb of the Georgetown Syncline and has been thinned by faulting along the west limb around Georgetown Canyon.

The Phosphoria Formation is exposed along the west limb of the syncline throughout nearly the entire length of Dry Ridge. The exposures along the east limb follow Snowdrift Mountain and Freeman Ridge in the southern half of the area. The Phosphoria is also present at depth below widespread exposures of Triassic and younger units in the central part of the Georgetown Syncline. All of the rock units exposed at the surface in the area, except the southern-most bit of Dry Ridge, are in the upper plate of the Meade Thrust. Exposures at the South end of Dry Ridge and in nearby areas comprise Jurassic rocks that lie beneath the Meade Thrust. The Phosphoria underlies these rock units here and elsewhere beneath the thrust. Because the character and distribution of the Phosphoria beneath the thrust are unknown, the phosphate resources there are not assessed.

The phosphate ore zones total about 45 feet thick in weathered rock and are estimated to be about 40 feet thick in the fresh rock. The total of the resources for the whole area is about 6 billion short tons of ore-grade rock. Of this amount about 1 billion short tons underlie Phosphoria outcrop, another billion occur at depths less than 2000 feet beneath Triassic rocks, and the rest is more deeply buried. The top of the ore is deepest in the northern part of the Georgetown Syncline--about 6500 feet.

The phosphate reserves of the area calculated by Garrand amount to about 150 million short tons, approximately 14 percent of the resources underlying Phosphoria outcrop. Of this amount, around 11

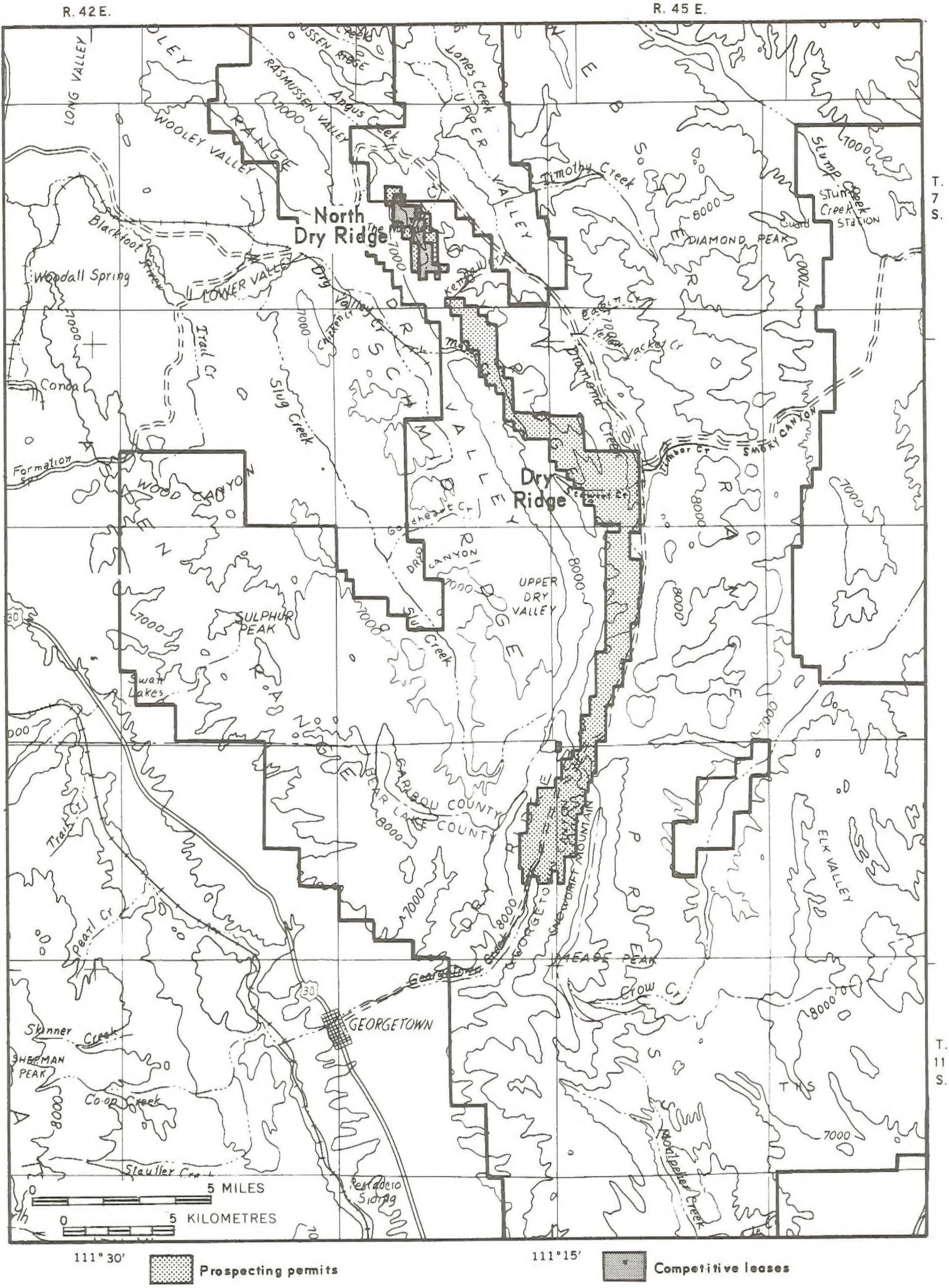

Figure 2-7.-- Prospecting permits and competitive leases applied for, Dry Ridge permit area and North Dry Ridge lease area.

million short tons have already been mined from open pits of the Georgetown Canyon and Maybe Canyon Mines. Additional production from North and South Maybe Canyon mines will produce 16.5 million short tons. IMC's proposed Husky No. 1 mine is expected to produce approximately 54 million short tons. The total amount of ore, therefore, that has been produced or is proposed for production is about 82 million short tons. This leaves about 70 million short tons of reserves.

Beker's competitive lease application at the north end of Dry Ridge extends north from the present Maybe Canyon mine to the Blackfoot fault. Most of the ore beds have steep (overturned) dips to the west, but near the present mine they have moderate eastward dips.

Landtype association 3 dominates the area. Associations 2 and 5 cover most of the rest, with very subordinate 6. Much of the area has high erosion potential, and most of it has steep slopes and elevations greater than 6,800 feet.

The northern part of the area drains via Dry Valley and Diamond Creeks into the Blackfoot River, part of the Columbia River drainage. The southern part drains via Georgetown Creek into the Bear River, part of the Great Basin drainage system. The North Dry Ridge lease area covers the headwaters of Mill Creek. Other perennial streams in the area include Deer, Diamond, Maybe, and Twin Creeks. Shallow water tables are likely in Diamond Creek and Dry Valley, although recent drilling showed that the permanent water table is at least 20 feet deep in Dry Valley and about 100 feet deep in Diamond Creek valley.

The area has excellent habitat for greater sandhill cranes and waterfowl along Diamond Creek and the Blackfoot River. This is also potential habitat for the newly-introduced whooping crane. It is major wintering area for deer, elk and moose, and it also contains critical elk calving areas necessary for a viable elk herd. Several deer and elk migration routes cross it. Excellent beaver habitat is found in the area. Diamond Creek and tributaries have a very good fishery, with cutthroat and brook trout, sucker, dace, and sculpin, and are important streams for cutthroat spawning and rearing.

Surface ownership is National Forest except for about 1 square mile of private land. The applications cover the part of Dry Ridge just east of the Phosphoria outcrop. Central Farmer's Coop's inactive mine and processing plant in Georgetown Canyon are just outside the area. Within the area, Beker's Maybe Canyon mine is currently active, and Beker's South Maybe Canyon mine (Part 5) and IMC's Husky No. 1 mine (Part 8) are proposed.

Access is by the Georgetown Canyon secondary road and utility roads. A partly dismantled rail spur extends into Georgetown Canyon. The existing rail spur to Maybe Canyon in Dry Valley borders the area on the north, and extension of that spur is proposed. The Union Pacific Railroad indicates that the proposed Diamond Creek spur could be extended to the south end of Stewart Flat with few construction problems, but that construction would be difficult south of there.

Recreation uses in this area consist primarily of hunting, driving for pleasure, horseback riding, fishing, ORV use and hiking. Hunting and driving for pleasure receive high use while fishing, horseback riding, ORV use and hiking receive moderate use. Fishing and driving for pleasure within the Narrows attracts many visitors to the area. The Snowdrift Mountain-Crow Creek inventoried roadless area is situated along the eastern boundary of the Dry Ridge permit area. The 17,920 acre roadless area has not been analyzed by land use planning procedures and is awaiting alternative consideration regarding its wilderness desirability so the resource values can be determined and future management direction set.

Until this determination is complete and made public through the NEPA process, the Forest Service is bound by its agreement with a Federal judge to protect the wilderness values the area may have.

The north part of Dry Ridge has a visual variety class of minimal, except for part of the North Dry Ridge lease are near the Blackfoot Narrows, which is classed as distinctive. The central part of Dry Ridge is rated common, and the south part, which includes part of Georgetown Canyon, distinctive. Land features are of moderate or better quality. The north half of the area is in the middleground viewing zone of secondary roads, the south half in the foreground viewing zone of the Georgetown Canyon-Diamond Creek road.

F. WEBSTER RANGE NORTH PERMIT AREA

The Webster Range North area comprises the western side of the range from slightly north of Timothy Creek southeastward about 9 miles to Smoky Canyon road (fig. 2-8). It includes several spurs from the range that extend into the valley on the east side of Diamond Creek. Dry Ridge adjoins the area to the west and Freeman Ridge abuts directly to the south. The northwestern part of the area forms the eastern side of the broad Upper Valley. All of the area is high, above 6,500 feet, and has a maximum relief of about 2,400 feet.

The main structure is the Snowdrift Anticline, along the crest of which are most of the Phosphoria outcrops. The anticline is faulted along most of its western limb, and the western limb is faulted out entirely by the Upper Valley range-front normal fault in the northern part of the area. All of the rock units exposed at the surface in the area are part of the upper plate of the large Meade Thrust. The Phosphoria probably is present also beneath thrust, but its character and distribution are too poorly known to assess the phosphate resources there.

The ore zones total about 50 feet thick in weathered rock and are estimated to be about 44 feet thick in fresh rock. The total resources of the area are about 2 billion short tons of ore-grade rock. Of this

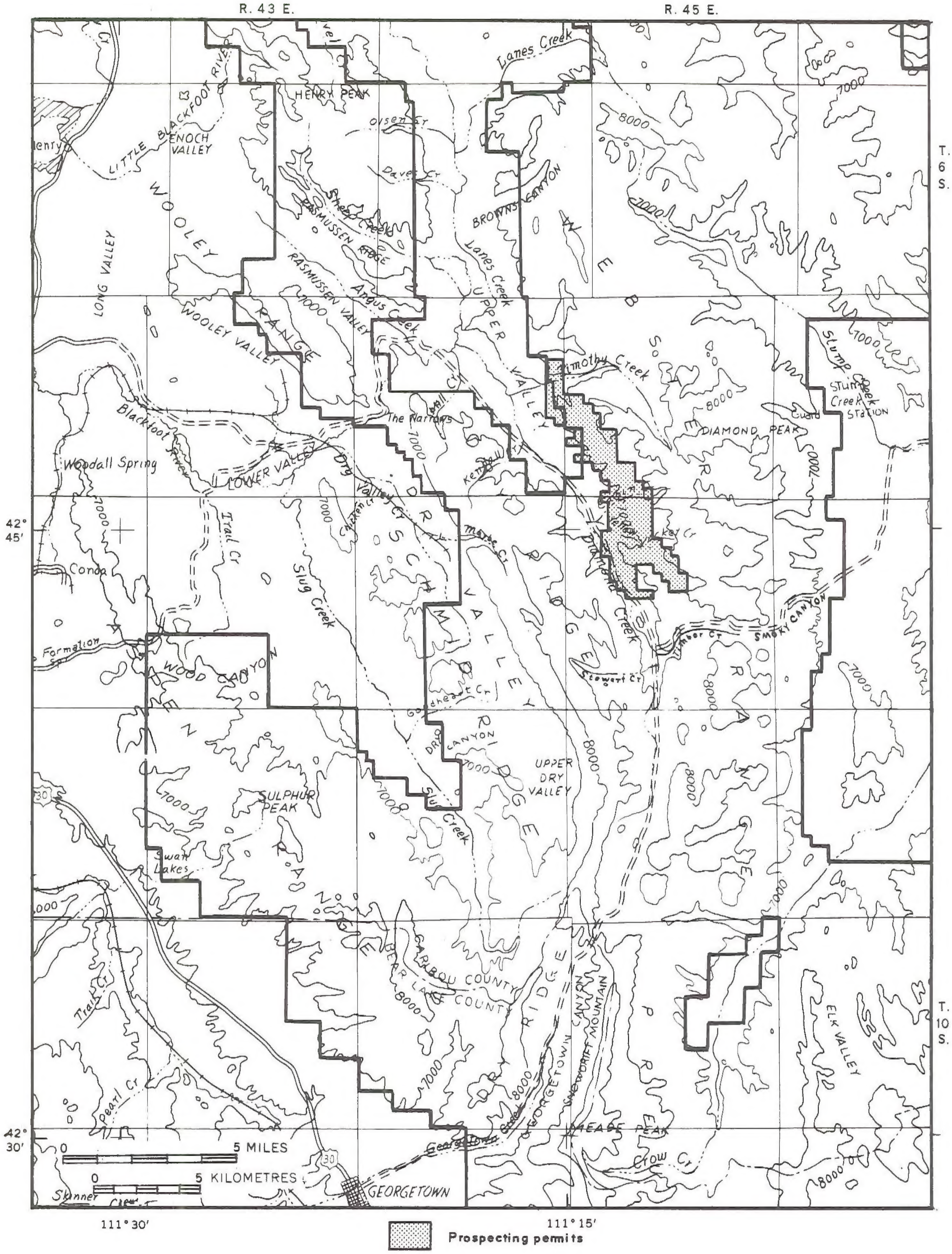

Figure 2- 8.--Prospecting permits applied for, Webster Range North permit area.

amount about 130 million short tons underlie the Phosphoria outcrop, about 700 million short tons occur at depths less than 2,000 feet beneath Triassic and younger units, and the rest is at greater depths--down to about 5,600 feet.

The phosphate reserves in the area calculated by Garrand are about 13 million short tons of phosphate rock, about 10 percent of the resources that underlie Phosphoria outcrop. No phosphate has been mined in the area, but the proposed Diamond Creek mine of Alumet Corporation is expected to produce 65 million short tons. The proposed production is 5 times the estimated amount of reserves and is due, in part at least, to Alumet's discovery of minable Phosphoria that was not included in the reserves calculation.

Landtype association 2 dominates the area; it has very high erosion potential on steep slopes from which vegetation has been removed.

The area includes Diamond Creek and several of its perennial tributaries. All drainage is to the Blackfoot River via Diamond Creek. The water table in the alluvium of Diamond Creek valley is about 30 feet below the creek level, and the Dinwoody and upper part of the Phosphoria Formation nearby contain water.

The area along Diamond Creek includes nesting and rearing grounds for greater sandhill cranes and waterfowl. Excellent elk calving grounds occur throughout the area. Winter range for deer, elk, and moose occurs throughout the area. Deer and elk migration routes cross the area. Diamond Creek has a very good fishery. Webster Creek contains cutthroat trout, exclusively of the Snake River variety. A fish hatchery, located in Idaho, but owned and operated by the Wyoming Game and Fish Department, is located at the mouth of Webster Creek.

Surface ownership is National Forest except for about 1 square mile of private land. The applications flank the eastern edge of the Phosphoria outcrop in the north half of the area and straddle it in the south half. There has been no mining in the area, but it includes Alumet's proposed Diamond Creek mine (Part 4).

Access is by the Diamond Creek secondary road and utility roads. A railroad is proposed in Diamond Creek.

Recreation use of the area includes hunting and fishing, with associated camping and pleasure driving and receives moderate levels of activity. The Diamond Peak and the Snowdrift Mountain-Crow Creek inventoried roadless areas are partly within the permit area. These areas have not been analyzed by land use planning procedures and should be evaluated and receive alternative consideration regarding its wilderness desirability so the resource values can be determined and future management set.

Until this determination is complete and made public through the NEPA process, the Forest Service is bound by its agreement with a Federal judge to protect the wilderness values the area may have.

The visual variety of the area is rated common or minimal, and land features are of moderate quality. The area is in the middleground viewing zone of the Diamond Creek road.

G. WEBSTER RANGE SOUTH PERMIT AREA AND CROW CREEK LEASE AREA

The Webster Range South area extends about 17 miles southward from the vicinity of Smokey Canyon in the Webster Range to the southern flank of Meade Peak (fig. 2-9). It lies just east of the Dry Ridge area and shares with that area part of Freeman Ridge and Snowdrift Mountain. The eastern border of the area includes parts of the valley of Crow Creek and Sage Valley. Meade Peak is the highest point (9,957 feet) in the entire southeastern Idaho study area, and much of the rest of the Webster Range South area is above 8000 feet.

The dominant structure is the Webster Syncline. The Snowdrift Anticline lies between the Webster Syncline and the Georgetown Syncline of the Dry Ridge area to the west. The Phosphoria Formation is exposed in the limbs of the Webster Syncline but is cut out by faulting at the southern tip of the syncline. A few outcrops occur in small fault blocks at the southern end of the area, where complex faulting has occurred near the trace of the Meade Thrust. The Phosphoria outcrop at the north end of the east limb turns east around the nose of a small anticline, whose eastern limb is cut out by faulting just south of the nose. The Phosphoria is also present at depth below exposures of Triassic and younger units. All of the rock units exposed at the surface in the area are in the upper plate of the Meade Thrust. The Phosphoria is probably present also beneath the thrust, but its character and distribution are too poorly known to assess the phosphate resources there. Faulting of the Webster Syncline is not severe, except near the southern end and along the eastern border where the trace of the Meade Thrust occurs.

The ore zones total about 48 feet thick in weathered rock and are estimated to be about 44 feet thick in fresh rock. The total resources of the whole area are about 5 billion short tons of ore-grade rock. Of this amount about 1.4 billion short tons underlie Phosphoria outcrop and about 1.7 billion short tons occur at depths less than 2000 feet beneath Triassic rocks in the Webster Syncline. The top of the Meade Peak is deepest in the northern part of the area, about 4100 feet.

The phosphate reserves in the area calculated by Garrand are about 211 million short tons of phosphate rock, about 16 percent of the resources underlying Phosphoria outcrops. None of the reserves have been mined, and none of the proposed mines are in this area. The Crow Creek competitive lease application (I-8933), however, has been filed for property at the southern end of the area. Two outcrops of the Meade

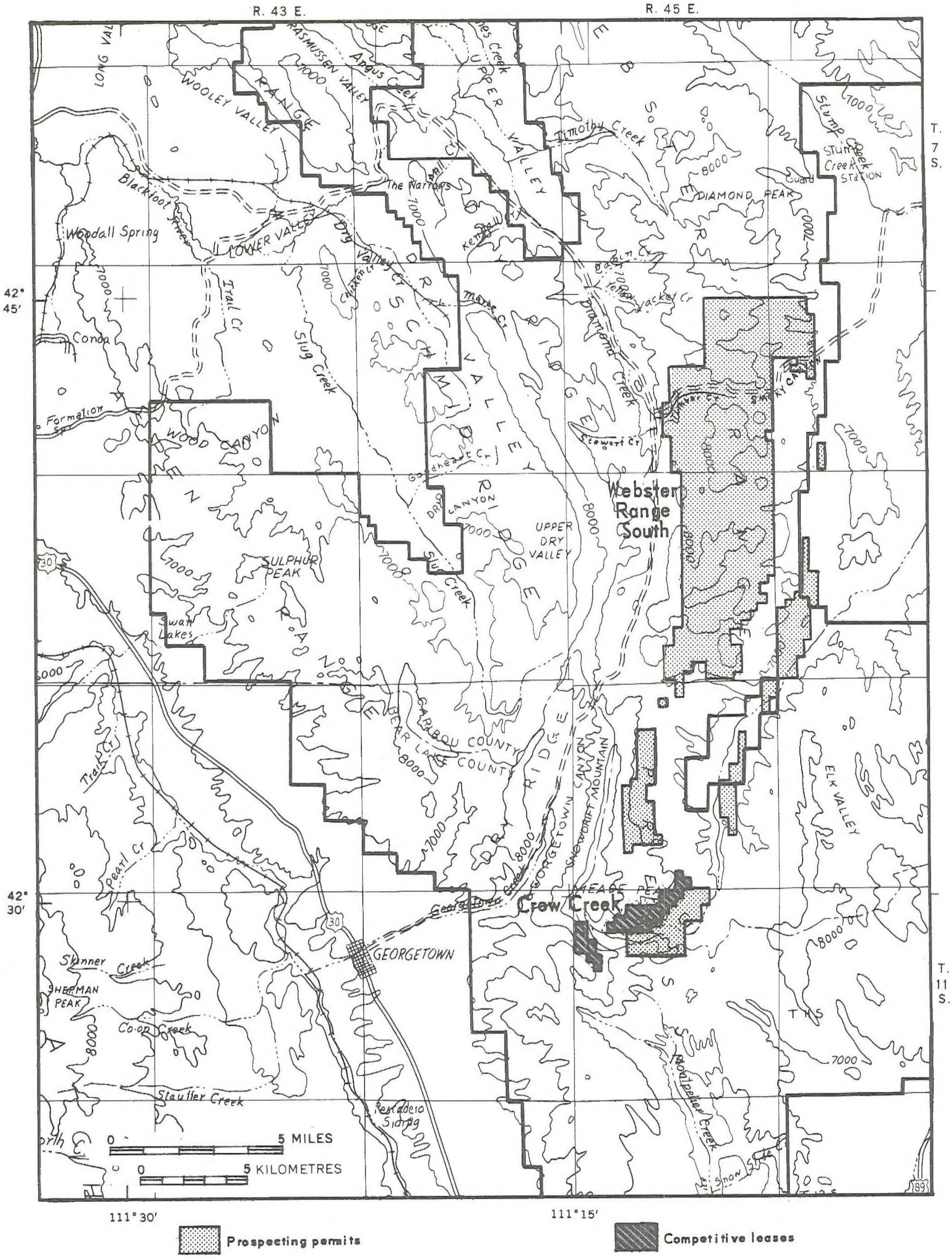

Figure 2- 9-- Prospecting permits and competitive leases applied for, Webster Range South permit area and Crow Creek lease area.

Peak are included in the lease area. The small western outcrop is separated from the other by faults and by a high and steep ridge extending south from Meade Peak (9957 feet), the highest point in the study area. All of the lease area is in high mountainous terrain and remote from access roads.

Landtype association 3 covers most of the area, associations 1, 2, 5, and 6 the rest. Probably less than one-quarter of the area has high erosion potential, but most of it has elevations above 6,800 feet.

The area includes perennial tributaries of Crow, Diamond, Sage, Tygee, and Webster Creeks. Nearly all the drainage of the area enters the Snake River system; only a small part of the southern end drains to Bear River and the Great Basin. Aquifers in the Dinwoody Formation in the Webster Range probably contain abundant ground water. Saline springs feed the headwaters of Crow Creek.

Excellent sandhill crane and waterfowl habitat occurs on part of Crow Creek, along parts of the eastern border of the area, and along Diamond Creek. Critical deer, elk, and moose winter range support an estimated 150 elk, 200 deer, and 40 moose. Excellent beaver habitat supports an estimated 60 beaver. Deer migration routes probably cross the area, and elk calving grounds border it on the south. Crow Creek is the most important fishery; it contains both Snake River and Henrys Lake varieties of cutthroat trout, as well as brown trout, sculpin, and possibly brook trout. Deer and Sage Creeks contain cutthroat trout, and their lower reaches may have brown trout. Webster Creek contains a pure strain of Snake River cutthroat trout.

Surface ownership is National Forest with very subordinate private land. Most applications lie downdip from Phosphoria outcrops. No mining has been done in the area, and none is proposed.

Access is by secondary and utility roads. Most of the area is isolated from present or proposed facilities for transporting ore, although an extension of the proposed Diamond Creek spur could extend into the west edge of the area (see Dry Ridge area).

This area contains excellent big game and bird hunting as well as fishing opportunities. Active recreational use is at a moderate level. There is limited driving for pleasure. ORV use is increasing.

The visual variety of the area is rated common, except for the southwest part of the range and parts of the Crow Creek lease area, which are rated distinctive. Land features are of moderate to high quality. The area is in the foreground and middleground viewing zones of Crow Creek and Smoky Canyon roads.

H. MONTPELIER CANYON PERMIT AREA

The Montpelier Canyon area is about 2 miles east of the town of Montpelier and is bisected by Montpelier Canyon and U.S. Highway 89 (fig. 2-10). The area is part of the Pruess Range, which separates Bear Lake Valley to the west from Thomas Fork Valley to the east. Montpelier Canyon is steep sided and the maximum relief in the area is about 1,600 feet.

The Montpelier Canyon area is structurally complex--largely bounded by faults and including small folds.

The ore zones total 53 feet thick, and the total resources of the area that underlie Phosphoria outcrop are about 85 million short tons. Because the area considered here was restricted to that covered by Phosphoria outcrop, resources of phosphate beneath Triassic rocks have not been considered. But vast resources of phosphate are present beneath Triassic and Jurassic rocks of the surrounding area of the Preuss Range.

The phosphate reserves of the area calculated by Garrand are about 20 million short tons, about 24 percent of the resources underlying Phosphoria outcrops. About 1.25 million short tons have been mined. No additional production has been proposed.

Landtype association 6, which has high erosion potential, covers about half of the area. Association 7, which has high slump and erosion potential, covers most of the rest. Both have steep slopes.

The area is drained by Montpelier Creek, which empties into Bear River. Several large springs indicate an abundance of ground waters some of them feed perennial streams that have been used for irrigation.

Deer and sage grouse winter in the area, and deer migration routes border the northwest corner. Montpelier Creek contains cutthroat and rainbow trout and sculpin.

Surface ownership is about 75 percent National Forest, 20 percent National Resource Land, and 5 percent private. The applications cover Phosphoria outcrop. The area includes San Francisco Chemical Co.'s inactive Waterloo mine but has no current or pending leases and no active or proposed mines.

Access is by U. S. Highway 89.

This area is heavily used for driving for pleasure and camping, especially along highway 89 in Montpelier Canyon. Hunting and ORV uses in the area are moderate.

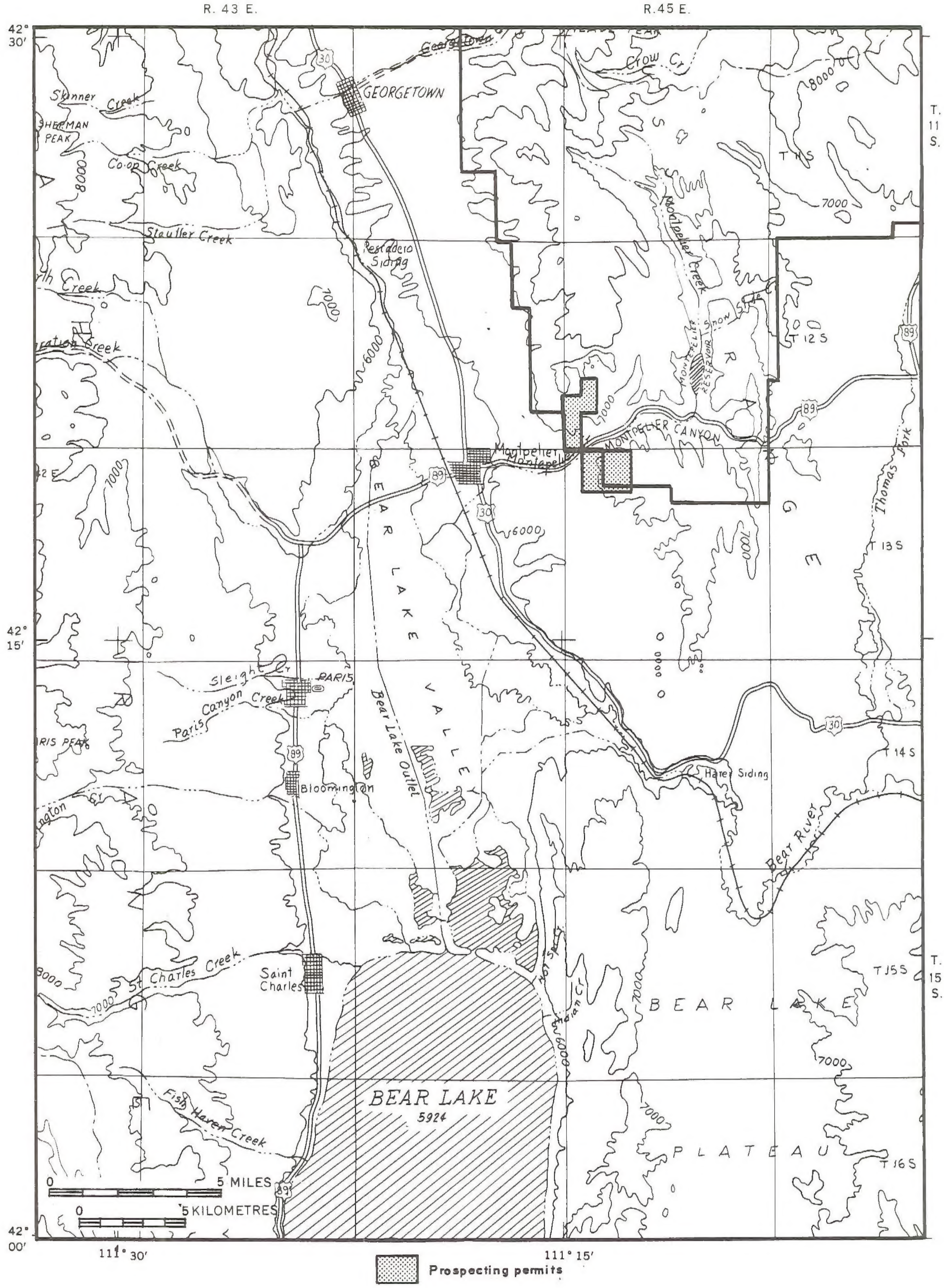

Figure 2-10.-- Prospecting permits applied for, Montpelier Canyon permit area.

The visual variety of the area is rated distinctive, and land features are of moderate or better quality. The area is in the foreground and middleground viewing zone of Highway 89. Land scars from previous mining are evident.

I. OVID-BLOOMINGTON PERMIT AREA

The Ovid-Bloomington area comprises part of the eastern front of the Bear River Range, which extends southward from Mill Creek, near Ovid, to Dry Canyon, near Bloomington (fig. 2-11). Through-going drainage has cut steep-walled canyons across the area, and all drainage is eastward into Bear River. Paris Peak, at 9,572 feet and one of the highest peaks of the region, is a few miles west of the area. Most of the area is between 6,000 and 7,000 feet.

The area comprises the Paris Syncline of the lower plate of the Paris (or Bannock) Thrust. The western border of the area is the thrust-fault contact, where lower Paleozoic rocks overlie upper Paleozoic and Triassic rocks along the west limb of the Paris Syncline. The syncline plunges northward, and the west limb is overturned. The eastern limb of the syncline is partly covered, the nose largely covered by Tertiary sediments. The Phosphoria crops out only in the nose of the syncline and along part of the west limb until it is covered by the Paris Thrust. The Phosphoria, however, underlies large areas with Triassic and Tertiary exposures.

The ore zones total about 20 feet thick in weathered rock and are estimated to be about 18 feet thick in fresh rock in the northern part of the syncline. The total resources of the area are about 500 million short tons of ore-grade rock. Of this amount about 35 million short tons underlie Phosphoria outcrop, about 150 million short tons occur at depths less than 2,000 feet beneath Triassic and younger units, and the rest is at greater depths--down to about 4,200 feet.

No open pit mining has been done in the area and none is proposed, due to unfavorable geologic conditions. Past production, in the early 1900's, was from underground mines and probably did not exceed 50,000 short tons. Production from the proposed underground Paris-Bloomington mine of Earth Sciences, Inc. is expected to be 45 million short tons of ore-grade rock.

Significant resources of vanadium and some associated rare elements also occur with the phosphate ore in this area. They are present in an approximately 10-foot interval of rock, called the vanadiferous zone, that directly underlies the upper phosphate zone of the Meade Peak. The content of vanadium is about 0.5 percent. Earth Sciences, Inc. also plans to mine this zone in conjunction with the upper phosphate zone and expects to produce about 70,000 short tons of vanadium. They also hope to recover selenium, silver, and zinc as byproducts.

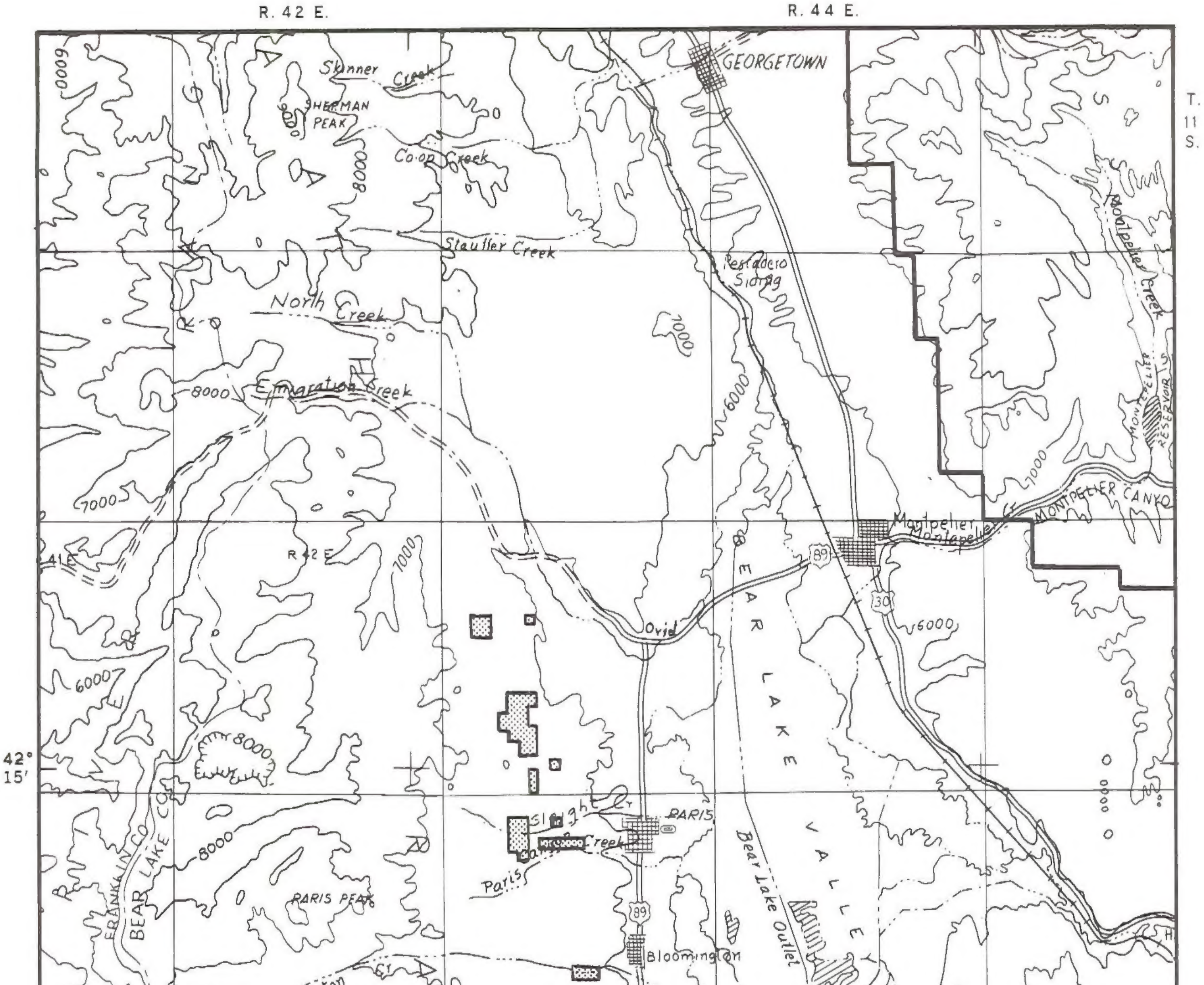

Figure 2-11.-- Prospecting permits applied for, Ovid - Bloomington permit area.

The vanadiferous zone also contains significant resources of cadmium and thallium, but there are no current plans to recover them.

Landtype association 7 covers almost all of the area. It has high slump potential.

The perennial Bloomington and Paris Canyon Creeks, cross the area. Perhaps a dozen springs occur in the area; they extend all across the foothills toward Dingle Swamp. Discharge of the largest ones, each estimated at several hundred gallons per minute, maintain high base flows in streams well into the fall. The water table is probably shallow, and aquifers in gravels of the Salt Lake Formation on the bench east of the Wasatch Range are probably perched.

The area includes prime sage grouse strutting grounds and deer winter range migration routes. Bloomington Creek is stocked with rainbow trout and supports brook trout. Paris Canyon Creek contains rainbow trout.

Surface ownership is 85 percent private and 15 percent National Resource Lands. Most applications are north of Phosphoria outcrops. Inactive mines are in Sleight and Bloomington Canyons. There is no current mining on Federal leases, but Earth Sciences, Inc. is currently developing private lands in Bloomington Canyon and proposes the underground Paris-Bloomington mine (Part 6).

Access is by secondary and utility roads. An abandoned rail spur ends about 2 miles from the area.

U. S. Highway 89 is an important recreational access route to Bear Lake from the North and is heavily used for pleasure driving. This area receives heavy snowmobile and bird hunting use and a moderate amount of ORV, horseback riding and fishing activity.

The visual variety for the area is rated common, and land features are of moderate quality. The area is in the middleground viewing zone of U.S. Highway 89.

CHAPTER III
ENVIRONMENTAL IMPACTS

Specific impacts cannot be predicted for the permit and lease areas, because prospecting and mining plans are not available. The general effects of prospecting will be relatively minor; most will be local and temporary. The effects of mining will be those described generally in Part 1 and described for specific areas near the permit and lease areas in Parts 4-11. This chapter thus discusses only those impacts that are of special significance or that are markedly different from the impacts discussed previously. Impacts on climate, air resources, soils, vegetation, agriculture and range, and socioeconomic development are not discussed here. No archeologic or historic sites are known in the area. Unknown sites would experience the impacts described in Part 1.

The impacts of prospecting on the physiography are minor; they include drill holes and pads, bulldozer cuts, and temporary access roads. Prospecting may have more significant effects on water resources; these effects are likely to be localized and minor. Some drill holes will drain perched aquifers. Others will intercept artesian aquifers, allowing them to flow into surface drainages. Holes that penetrate more than one aquifer will allow flow between aquifers; consequent mixing may alter water quality. Trenches may modify recharge or intercept underflow near streams, increasing evaporation--but only negligibly. Backfilling the trenches with re-sorted materials could impede the underflow and cause it to surface. Surface disturbance will increase runoff and erosion; because the disturbance is surficial and local, the effects will be slight and local. Areas of steep slope, high elevation, fragile vegetation, heavy snow accumulation, and high runoff will be most susceptible to damage.

If surface mining ultimately takes place, landsurface, vegetation, wildlife, fish, recreation, and aesthetics will generally be impacted in ways described in Part 1.

In general, impacts may be greater than those described previously because many of the permit and lease areas are higher and more rugged and remote than areas with active or proposed mines. But mining through much of the area will probably be underground, with concomitantly reduced impacts, as described in Part 6.

A. CHESTERFIELD AND RESERVOIR MOUNTAIN PERMIT AREAS: EAST FORT HALL LEASE AREA

Surface disturbance may cause severe erosion or slumping in most of the area. Drilling could have a extremely high impacts on ground water, and ground water beneath the Blackfoot Lava Field could be easily contaminated because of the permiable character of the lava. Prospecting operations elsewhere would probably have only local effects on ground water. Surface mining would have high long-term impacts on wildlife and low, short-term impacts on fish. Impacts on recreation would be moderate on the East Fort Hall area but low elsewhere. Impacts on aesthetics would be low.

B. WOOLEY AND GRAYS RANGE PERMIT AREAS: PELICAN AND WILSON RIDGES AND HENRY NORTH CONTINUATION LEASE AREAS

Many impacts will be similar to those for the proposed Henry North Continuation (Part 9), Wooley Valley Unit 3 (Part 11), and Rasmussen Ridge (Part 11) mines. Surface disturbance may cause severe erosion and slumping in about half of the area and degrade water quality in the Blackfoot and Little Blackfoot Rivers and in several perennial streams. Drilling and trenching will intercept shallow ground water in the Enoch-Little Blackfoot and Rasmussen Valleys, but impacts will probably be minor.

Surface mining would have a high impact on deer, elk, cranes, and waterfowl. The impact on fish would be high for Angus, Lanes, and Sheep Creeks and the Blackfoot River in the south part of the area and for the Little Blackfoot River in the Henry North area, but they would be negligible elsewhere. Impacts on recreation would be high. Surface mining would have a generally high aesthetic impact on the area.

C. ASPEN RANGE PERMIT AREA

Many impacts will be similar to those for the proposed Swan Lake Gulch (Part 4), Henry North Continuation (Part 9), Caldwell Canyon (Part 9), North Trail Canyon (Part 10), and Middle Sulphur Canyon (Part 10) mines. The rugged topography will increase the physiographic impacts of prospecting and mining. Drilling could affect the municipal water supply for Soda Springs as well as local supplies by draining perched aquifers or tapping the Dinwoody aquifer in the range or the basalt aquifer east of Soda Springs. Drill holes in widespread tufa deposits might tap waters charged with carbon dioxide; effervescent flowing holes might preclude further development and reduce the quality of surface waters. Trenches in the valleys of Johnson, Slug, and Trail Creeks will intercept shallow ground water, but the increase in evaporation and the impeding of underflow by backfilling will be negligible.

The impact of surface mining on deer winter range would be severe and long-term and elk would be severely affected locally. The impacts on fisheries would be insignificant, except for Slug Creek and Swan Lake, where they could be moderate. Impacts of mining on recreation and aesthetics will be moderate or less, since much mining here would probably be underground.

D. SCHMID RIDGE PERMIT AREA AND DAIRY SYNCLINE LEASE AREA

Many impacts will be similar to those for the proposed Champ (Part 5) Mountain Fuel (Part 5), Dry Valley (Part 7), and Caldwell Canyon (Part 9) mines. Surface disturbance could cause significant erosion in most of the area. Trenching will intercept shallow ground water in Slug Creek or Dry Valleys, but the increase in evaporation and the impeding of underflow by backfilling will be negligible. Impacts on the ridges are likely to be lessened by underground mining. Drilling and trenching could reduce the flow of springs on the east side of Schmid Ridge and affect wells in upper Dry Valley. Impacts of surface mining would be low on fisheries, except for Slug Creek, where they could be moderate. They would be severe and long-term on deer, elk, greater sandhill cranes, forest grouse, and waterfowl. Impacts would be moderate on recreation. They would be generally moderate on aesthetics but high for the Dairy Syncline and the north tip of Schmid Ridge near the Blackfoot Narrows.

E. DRY RIDGE PERMIT AREA AND NORTH DRY RIDGE LEASE AREA

Many impacts will be similar to those for the proposed South Maybe Canyon (Part 5) and Husky No. 1 (Part 8) mines. The rugged topography and generally high elevation of the area will increase the physiographic impacts of prospecting and mining. Surface disturbance could cause serious erosion in about half of the area and reduce water quality in several perennial streams.

Trenching in the alluvium of Diamond Creek may intercept shallow ground water, slightly and locally increasing evaporation and impeding underflow. Mining on Dry Ridge would probably be underground, with impacts similar to those described in Part 6. Surface disturbance in the North Dry Ridge area will degrade water quality in Mill Creek.

Surface mining could have a severe long-term impact on deer and elk. Fisheries would be strongly impacted by degradation of Diamond Creek or the Blackfoot River, but impacts elsewhere would be low. Impacts of surface mining on recreation would be high. Impacts on aesthetics would be generally high, and serious on North Dry Ridge and in upper Georgetown Canyon.

F. WEBSTER RANGE NORTH PERMIT AREA

Many impacts will be similar to those for the proposed Diamond Creek mine (Part 4). Prospecting and mining could cause serious erosion throughout the area, especially on steep slopes at high elevations. Trenching in the alluvium of Diamond Creek may intercept shallow ground water, slightly and locally increasing evaporation and impeding underflow. The quality of surface and ground water would be impacted by prospecting and surface mining in the Diamond Creek valley in the west part of the area. Cutthroat trout populations would be seriously reduced in Diamond and Webster Creeks. Deer, elk, crane, and waterfowl populations also would be seriously reduced. Impacts on recreation and aesthetics would be high, especially along Diamond Creek. Underground mining is likely in the east part of the area, with concomitantly reduced impacts.

G. WEBSTER RANGE SOUTH PERMIT AREA AND CROW CREEK LEASE AREA

The impacts of prospecting and mining would be severe because of the ruggedness and remoteness of the area. Ground water relations and quality in the aquifers of the Dinwoody Formation in the range could be modified by prospecting and mining, but the effects would probably not be felt outside the range. Surface mining would increase sediment loads in the many perennial streams that cross the area, especially in the high, steep parts of the area, and most particularly in the headwaters of Crow Creek and a section of Smoky Creek that flows along the outcrop trace of the Phosphoria Formation. Saline water could be diverted into new drainages. Trout (notably cutthroat) populations would probably be seriously reduced in Crow, Deer, and Sage Creeks. Waterfowl and sandhill crane populations also would be reduced. Surface mining near Sage Valley and south of Wills Ranch would seriously reduce deer, elk, and moose populations, but most mining elsewhere in the area is likely to be underground and will thus have reduced impact. Impacts of surface mining on recreation would be serious in the Crow Creek area and high elsewhere; impacts on aesthetics would be high.

H. MONTPELIER CANYON PERMIT AREA

Impacts would be generally increased by the ruggedness of the area. Surface disturbance could cause serious erosion and locally encourage slumping. Prospecting or mining could reduce the flow of large springs in the area. Mining would degrade the quality of lower Montpelier Creek, moderately reducing fish populations. Deer and grouse populations also would be moderately reduced. Ore hauling if permitted on U.S. Highway 89 would compete with other traffic. Surface mining would have serious impacts on recreation and aesthetics, although aesthetic values of the area are already reduced by scars from previous mining that are clearly visible from the highway.

I. OVID-BLOOMINGTON PERMIT AREA

Surface disturbance will encourage slumping throughout the area. Otherwise, the impacts of prospecting and mining will be relatively small; the Phosphoria Formation is not exposed in most of the area, so much future mining will probably be underground. The flow of some springs may be reduced, and shallow aquifers may be drained or contaminated. Surface mining would have severe long-term impacts on deer and sage grouse, moderate impacts on fish, high impacts on recreation, and high impacts on aesthetics.

CHAPTER IV
MITIGATING MEASURES

This part considers only measures for reducing impacts due to prospecting. Measures for reducing the impacts of mining are discussed in Part 1; many of those measures apply to prospecting as well.

The U.S. Geological Survey's Operating Regulations for Exploration, Development, and Production (June 1, 1972) apply to exploration and development of phosphate in the area. The Mining Supervisor inspects the operations to enforce the regulations. The operators are required to take necessary action to avoid, minimize, or repair soil erosion, pollution of air or water, damage to vegetation, or injury to fish and wildlife. The Mining Supervisor may require the operator to install monitoring systems. Drill holes must be abandoned to the satisfaction of the Mining Supervisor; they must be cased or plugged unless they are to be used for monitoring. Finally, plans must be submitted for revegetation and reclamation in compliance with 30 CFR 231.20 (b)(c).

Other mitigating measures can also be implemented.

Particular care should be taken in drilling in areas with carbon-dioxide-charged waters (for example, west of Reservoir Mountain and west of the Aspen Range) and in areas with saline waters (Crow Creek lease area). At high elevations, where the growing season is short, special care should be taken in revegetating, especially with erodible soils on steep slopes. Conveyor systems should be considered to minimize impacts in rugged areas that are isolated from transportation facilities, possible on Dry Ridge and the Webster Range North areas.

Mitigation measures should include a program of archeological test excavation in advance of prospecting and the stipulation that archeologic artifacts discovered during prospecting operations be reported immediately and that further work in the vicinity be postponed until the find is evaluated by a competent archeologist.

CHAPTER V
ADVERSE EFFECTS THAT CANNOT BE AVOIDED

Damage from bulldozing, drilling, and other prospecting operations will be relatively minor: most will be surficial, local, and temporary. Clearing land will locally modify drainage patterns and increase runoff and erosion. Drill holes that are unsuccessfully cased or plugged will drain perched aquifers; intercept artesian aquifers, allowing them to flow into surface drainages; and allow flow between aquifers, possibly altering water quality. Backfilled exploration trenches may impede shallow underflow, creating local marshes or ponds. Archeological sites could be destroyed.

The unavoidable adverse effects of mining are described generally in Part 1 and more specifically in Parts 4 to 11. Part 6 is especially relevant because of the likelihood of more prevalent underground mining.

CHAPTER VI
SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY OF THE AREA

Most prospecting operations will have only local, surficial, and temporary effects. Prospecting trails will probably recover native vegetation in a few years. Drainage patterns may be permanently disturbed, and ground-water relations could be permanently changed by drilling if reclamation techniques fail; but such changes would be very localized, and most of them would be insignificant.

Mining will affect long-term productivity as described in Part 1. Underground mining will probably be more prevalent than it is now. Its general effects are described in Part 6.

CHAPTER VII
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Leasing will irreversibly commit the resource to mining; prospecting may result in a lease with this commitment. Part 1 discusses the impacts of mining.

Drill holes that are unsuccessfully cased or plugged could permanently reduce some ground-water resources or degrade water quality, but that effect will be local and negligible.

CHAPTER VIII

ALTERNATIVES

In view of legislated responsibilities under the mineral leasing laws, given all applications being in good order, it may be safely assumed that some further leasing will be authorized at some future time.

A variety of options are avilable to the Secretary of the Interior when considering applications for phosphate permits and leases under the Mineral Leasing Act. Chapter VIII of Part I details the various alternatives to the leasing actions proposed, which are applicable across the land in a regional context. That chapter is incorporated here by reference. Implicit in that discussion is the possible selective application of the various administrative alternatives, case-by-case, in the decision making process. For example, one application may be approved, another rejected, and yet others deferred or modified by conditions of approval, depending on the individual merits of each application.

A variety of options are available to the Secretary of the Interior when considering applications for phosphate prospecting permits and leases under the Mineral Leasing Act. In this section, five different types of action are addressed: (1) prospecting-permit applications; (2) preference-right-lease applications; (3) competitive-lease applications; (4) fringe-acreage applications; and (5) re-adjustment of lease terms and conditions. The last named is provided for by the terms of the lease. The issuance of preference-right leases, if the application is valid in all respects, is essentially a non-discretionary action under the leasing laws. In the matter of prospecting permits and competitive-lease and fringe-acreage-lease applications, the Secretary has full discretion in his action thereon.

In considering the applications for prospecting permits and new competitive leases, the Secretary may issue or deny approval so as to regulate future development as to both acreage and locations. He may also declare a moratorium on such issuances if appropriate, as was recently done on the Federal coal reserves.

In southeastern Idaho, such issuance could be predicated upon a policy of maximum resource development commensurate with minimum environmental impact. Further prospecting in southeastern Idaho, if desirable, could be limited to those areas of least environmental impact. Part 2 identifies nine general areas and the impacts associated with prospecting and possible mining in each of them. Of these areas, the more significantly impacted are the Aspen Range area, the Webster Range areas, and the Crow Creek area. The environmental impacts are discussed in Part 2. The alternatives available to the Secretary, as listed in Part 1, are repeated here.

1. NO ACTION

With respect to preference-right-lease applications, if the application is valid in all respects, and if discovery of a valuable deposit has been demonstrated in accordance with existing regulations (43 CFR 3520 and 3521 as Amended May 7, 1976), this lease will be issued. (See discussion of the procedure in Part 2, Chapter 1). In this procedure the Secretary will attach such terms and conditions as may be necessary to assure maximum environmental protection and the protection of the public interest. Having issued a prospecting permit, the Secretary is obligated to act on any resulting preference right applications. Thus, the alternative of "no action" is not viable or reasonable if the applicant has met all the requirements of the regulations. It is possible that the Congress could enact legislation that would alter present circumstances in one way or another. However, to date the Administration has not requested such action, and the Congress has not initiated or considered such legislation; the possibility thereof is conjectural at best. If legislation were passed which cancelled all existing prospecting permits and preference-right-lease applications, the effects would be similar to those previously described under heading 3.b. of this chapter, entitled "Cancel the leases."

If the Secretary so elects, he need take no action on pending prospecting-permit, competitive-lease, or fringe-acreage lease applications. Under existing law, he is empowered to approve such applications but is not required to do so in any given instance. The results of taking no action on the existing application would be to preclude additional incremental environmental impacts on the area from mining operations on the mineral properties under application. Those properties would continue in their present conditions, subject to further modification by natural processes and such other uses as the land-managing agencies may elect or permit. To the extent that production of phosphate from the properties would be foregone, alternative sources would be required to meet the need. Alternative sources of phosphate and the related impacts are described later in this chapter. Other effects would be: (1) little or no additional geologic and mineralogic information would be obtained in presently unexplored areas; (2) the future value of present leases and the non-federally-owned deposits would appreciate; (3) mining of the Federal resource beyond present lease boundaries would be precluded and would preserve the resource for the future; (4) operators with limited ore reserves would either cease operations in a short time or seek other available sources; (5) operators with substantial ore reserves could significantly influence future production and location of phosphate mining in Idaho; and (6) mining in the more remote areas now under lease possibly would be accelerated.

By taking no action on pending or future prospecting-permit applications, the Secretary would preclude any loss of his discretion in future leasing actions but would simultaneously increase the cost to the government for evaluating the resource and processing all future lease sales. Under such conditions, it would be necessary for the Government rather than permittees to obtain the minerals exploration data needed to evaluate the mineral deposit proposed for sale.

For practical purposes, implementing the "no action" alternatives would contribute to "preventing further development" and would have the same result as "rejecting the applications."

Under the terms of Section 3, (e) of the lease, the lessor reserves the right to readjust the terms of the lease, including, among others, royalty rates and environmental requirements, at 20-year intervals. The exercise of that right is discretionary, and it would be appropriate to presume that some affirmative action will take place in this regard. The effects of taking no action to readjust lease terms would be to forego modernizing the lease terms and increasing royalty rates, when appropriate, to the general benefit of the public interest.

2. REJECT THE APPLICATIONS

This alternative differs from the preceding "no action" alternative only to the extent that a discrete administrative action is taken in response to the applications for prospecting permits and various types of leases. The same constraints would apply to discrete rejection, and the same impacts would flow from rejection as from "no action."

3. DEFER ACTION ON APPLICATION

For a temporary period, this alternative has already been utilized. For example, actions relative to permit and lease applications and the readjustment of terms and conditions have been stayed pending the completion of this environmental impact statement.

In the short-term, the Secretary may defer action on preference-right lease applications on other proper grounds. These could include, but not be limited to the need and time required for:

---modification of the proposal to correct administrative or technologic deficiencies.

---redefinition of the acreage involved to avoid unacceptable environmental impact of future development.

---acquisition of additional data to provide an improved basis for technical or environmental evaluation.

---further evaluation of the proposal and/or alternatives. The principal effect of deferring action on such applications would be a comparatively short-term delay in the imposition of all related impacts of the proposal, both adverse and beneficial.

In the long-term, this alternative is subject to the same constraints and would result in the same impacts as described in the preceding subsection on "no action."

4. IMPOSE NEW GENERAL TERMS AND CONDITIONS ON PROSPECTING PERMITS AND LEASES

The present general terms and conditions of the phosphate permits and leases are derived basically from the Mineral Leasing Act of 1920, as amended, and amplified by regulations of the Secretary of the Interior.

Within present statutory restraints of the Mineral Leasing Act of 1920, as amended, the Secretary of the Interior may impose terms and conditions to permits and leases. Basically, this broad authority vested in the Secretary of the Interior relates to exploration and mining operations under permits and leases, respectively. New regulations or operating directions could be issued whereby more stringent terms and conditions would be imposed. Such action is presently pending under proposed regulations for surface management and mining operations on Federal coal deposits.

New general terms and conditions relative to the acquisition, exploration, development, extraction, and reclamation of Federal phosphate deposits could also be directed by new or amendatory legislation.

With respect to prospecting permits, broad authority is vested in the Secretary to promulgate regulations to govern explorations under such permits. Additionally, a wide variety of conditions of approval may also be applied on a case-by-case basis. Those which will or could be imposed on those applications now pending have been identified in Chapters IV, "Mitigating Measures," in Parts 1 and 2 of this statement.

5. APPROVE THE APPLICATIONS

Approval of the prospecting permits would open the Western Phosphate Field to further leasing at the discretion of industry in locations of their selection. Based upon past experience of conversion of permits to leases, it would likely increase the extent of federal leases from 43,370 acres to perhaps 51,000 or more, thereby committing an additional 8,500 acres to future mining.

Approval, if granted, would have to be programmatic rather than site-specific, inasmuch as site-specific environmental analyses and supplemental environmental statements as necessary, have not been performed on an application-by-application basis. Under this general approval, each of the applications would require an individual analysis to determine site-specific impacts, and may not be issued if impacts are determined unacceptable. The analysis of overall impacts as described herein, however, are sufficient for overall consideration of a program of issuance of prospecting permits.

PART 3

TRANSPORTATION AND UTILITY SYSTEMS

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PART 3
TRANSPORTATION AND UTILITY SYSTEMS

CHAPTER I
DESCRIPTION OF ACTION UNDER CONSIDERATION

A. INTRODUCTION

To a large degree, the viability of phosphate mining operations in southeastern Idaho depends on a transportation system that will insure efficient and economical ore haulage and provide safe and dependable year-around access to the mine sites.

The transportation and utilities systems which would provide joint access service, and ore transport facilities for the various proposed mining operations are discussed in this part. These systems form the infrastructure necessary to supply phosphate rock to the processing plants.

Part 3 unifies the general discussion and analysis of the major transportation and utilities systems in southeastern Idaho covered in Part 1 and the discussion and analysis of the transportation and utilities systems unique to each mining proposal covered in Parts 4 through 11.

B. RAILROADS NETWORK

The railroad network assumed by the Task Force in the draft statement was planned by the Union Pacific Railroad to accommodate all of the mines for which rail transport was indicated as a preference. Use of such a system will minimize duplication or paralleling of haulage systems, as inevitable in plans submitted independently by the eight companies. This plan (fig. 3-1) could also serve some mines that did not show railroad as the preferred mode of transportation, and could be extended to accommodate mining development in future years, beyond the scope of this study.

The network was designed to the following specifications. Grades are not to exceed 0.82%, curve compensated, adverse to the loaded trains. Adverse grades not to exceed 1.5% curve compensated, are allowed in the opposite direction. A maximum of 10-degree curves are allowed. All trackage is to be paralleled by a service road not less than 10 feet wide measured outside of 11 feet from the center line of the railroad. Where a double track system is employed and the tracks are adjacent to each other, only one service road is required.

Through the use of railroad loops, one-way traffic coupled with a complete two-way communications network and rapid loading and unloading of the ore trains, the Union Pacific expects to develop an efficient haulage system that is responsive to customers' needs. Haulage of ore by rail will continue to be limited to about six months per year due to ore freezing in the gondola cars in cold weather.

The anticipated traffic on this system requires double track from Soda Springs north to the Blackfoot River and eastward up river to Mile 13.94, according to Union Pacific engineers. The new track to be added will closely parallel the existing track as much as possible within the constraints of the foregoing specifications and the dictates of topography for about 20 miles in total length. The new track will be used for the loaded trains coming from the mine, the existing tracks for empty trains returning to the mines. Ore haul is expected to reach a maximum of 100,000 tons per day. Assuming unit trains of 100 cars of 100 ton capacity each, ten trains per day can be expected. Because of the volume, railroad highway signals and/or adequate signs will be required for public safety.

The Slug Creek-Dry Valley loop (fig. 3-1) will start at Mile 13.94 on the existing line and run south through Slug Creek valley, veering to the west side of the valley to facilitate haulage from Monsanto's Trail Creek mine. From the Trail Creek mine the railroad will run eastward to the east side of the valley; thence southeast to Dry Canyon; thence east through Dry Canyon to Dry Valley; thence northwest through Dry Valley to rejoin the existing railroad at Mile 16.97. This loop with one spur and connecting track included measures 25.15 miles, of which 10.0 miles will be on the Caribou National Forest and 0.2 miles will be on Bureau of Land Management land. This loop will accommodate transportation needs for Monsanto's Trail Creek and Caldwell Canyon mines, I.M.C.'s Husky No. 1 mine, Beker Industry's Maybe Canyon, Mountain Fuel, and Champ mines, and F.M.C.'s Dry Valley mine. An alternate route through Goodheart Canyon is provided should the Dry Canyon route prove unacceptable. Another alternate segment of railroad is along the east side of Slug Creek valley to better accommodate the Caldwell Canyon mine. Monsanto plans to deplete the Trail Canyon mine before starting the Caldwell Canyon mine; the alternate would thus be built in the distant future if warranted. Actually the railroad as planned, without the alternate, appears adequately close to either end of the Caldwell Canyon mine to serve that mine.

The railroad will lie on 8.7 miles of Forest Service land in Dry Valley. The route will stay close to the edge of the valley, wherever possible, to avoid softer ground in the valley center. About 1.3 miles will lie in Dry Canyon on Forest Service land. A narrow canyon connects Dry Valley and Slug Creek valley. The canyon now contains a secondary road. The addition of a railroad may present some space conflicts and construction difficulty.

In Slug Creek valley the railroad will cross one-half mile of BLM land in Section 30, T. 8 S., R. 44 E. The route here will skirt the edge of the valley to stay on firm ground and parallel an access road.

The loop will haul a maximum of about 70,000 tons of ore per day, assuming Monsanto's Trail Creek and Caldwell Canyon mines ship by rail. Without Monsanto's ore, a maximum of about 63,000 tons per day can be expected. Roughly 220 acres would be disturbed by this loop.

The Blackfoot Narrows spur (fig. 3-1) will leave the existing railroad at Mile 14.0 and follow the Blackfoot River northeastward and eastward through the Blackfoot Narrows to Upper Valley. The railroad

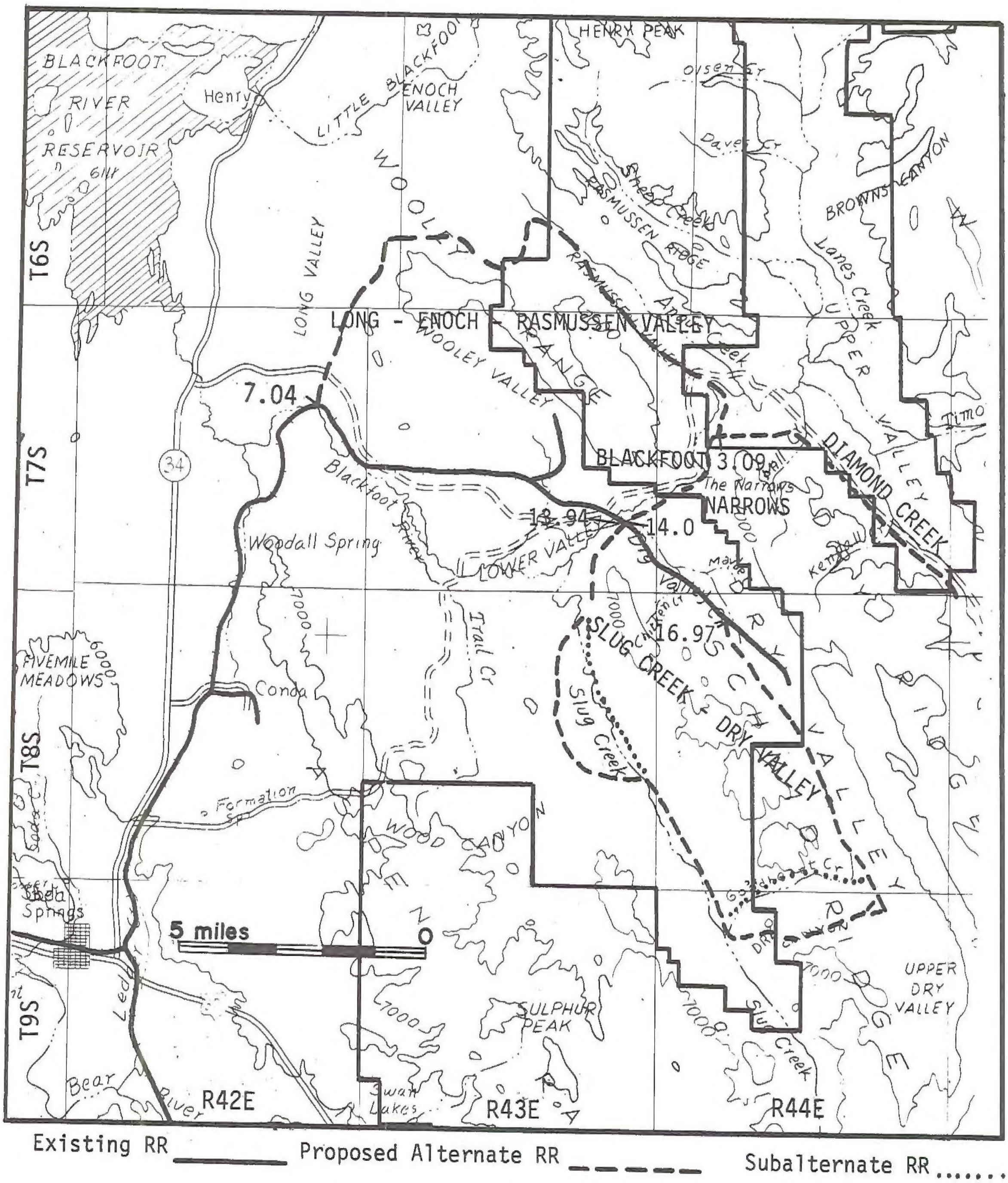


Figure 3-1.--Proposed railroad network.

will then run southeast along the west side of Upper Valley to terminate at the south side line of Section 31, T. 7 S., R. 45 E. This spur has a total length of 10.3 miles, 3.7 miles of which are on national-forest land and 0.2 mile on BLM land. Of the mining plans considered in this Environmental Impact Statement, this spur will serve only the Diamond Creek Mine of Alumet Corporation. Other extensive reserves in the area will certainly be exploited in the future, thus further justifying this spur. It is feasible to extend this spur southeast up Diamond Creek an additional 5.5 miles to Stewart Flat to accommodate future mining development. All such extension would be in Caribou National Forest. Beyond Stewart Flat the terrain becomes too steep for a railroad.

The spur will traverse 1.8 miles of Forest Service land in the Blackfoot Narrows. The canyon accommodates an existing access road along the Blackfoot River. Construction of the railroad here will meet engineering difficulties and space conflicts. As it passes southward along the west side of Diamond Creek Valley, it passes over three short segments of Forest Service land, totaling 1.9 miles, and 0.2 miles of BLM land. The railroad here parallels an existing access road. Alumet plans to calcine their ore at or near the mine site and ship calcined product all year long. This would average about 7,000 tons per day, or about three trains per week. About 280 acres would be disturbed by construction of this spur.

The Long-Enoch-Rasmussen Valley railroad loop (fig. 3-1) will leave the Upper Valley branch at Mile 3.09, run northeast for about one mile, turn northwest, cross the Blackfoot River, run up Rasmussen Valley, and descend into Enoch Valley. Skirting the upper or south end of Enoch Valley, the railroad will pass the Henry Mine then turn westward to Long Valley. It will then run southwest along the east side of Long Valley to join the existing railroad at Mile 7.04. This loop is 15.83 miles in length, and will serve Stauffer Chemical Company's Rasmussen Ridge mine. Though this railroad loop passes Monsanto's Henry mine, it is doubtful that Monsanto would ship ore by rail, as they have a proprietary haul road and truck fleet currently hauling to their Soda Springs plant.

The loop, as it passes along the west side of Rasmussen Valley, traverses about five miles of valley grassland used for summer grazing, about 2.5 miles of which will be on Forest Service land. Leaving Rasmussen Valley, the route stays on hillside slopes and skirts the south end of Enoch Valley, for a distance of about five miles. Side slopes are moderate to steep. Leaving Enoch Valley the route passes westward through a canyon in Section 25, T. 6 S., R. 42 E. and Section 30, T. 6 S., R. 43 E., a distance of about a mile. The route through this canyon will be along the canyon floor paralleling an existing access road and Monsanto's ore-haul road. Current value of the land in this canyon is as a road corridor. Leaving the valley the route turns southward, staying close to the foothills on the east side of Long Valley and joining the existing railroad at Mile 7.04. The loop will haul about 7,000 tons of ore per day on three to four trains per week.

About 290 acres would be disturbed by construction of this loop. The part of the loop in the Blackfoot Narrows (Section 18, 19, and 20 of T. 7 S., R. 44 E.) may prove unviable by reason of unacceptable environmental impact or high cost. Should this prove the case, then the first 5.6 miles of the Upper Valley-Diamond Creek branch would be eliminated from the plans along with the first two miles of the Rasmussen Valley-Long Valley loop. The remaining portions of the two parts would be joined by about 1.5 to 2.0 miles of track in Section 8, 9, and 16 of T. 7 S., R. 44 E., B.M. The resulting branch line would then be about 25 miles in length, 4.4 miles of which would be on national-forest and 0.2 miles on BLM land.

The Union Pacific Railroad proposes to build a spur line to service a processing plant planned by Earth Sciences Inc. near the town of Bloomington, Idaho. The spur line will leave the Union Pacific Railroad yard at the south side of Montpelier, run westward and southwestward to the vicinity of the town of Ovid, and thence southward to the vicinity of the town of Paris. The line will veer eastward at this point, then southward by-passing Paris, thence southwestward, then southward to terminate immediately east of the town of Bloomington. This spur will be 11.4 miles in length, about 5.5 miles of which will be on abandoned railroad bed. No federal lands are traversed by this spur. About 80 acres will be disturbed by construction of this spur.

In summary the rail system as planned will add 60.1 to 65.7 miles of trackage to the area, depending upon which combination of proposed loops and branches prove most economically feasible and environmentally acceptable. The system will occupy about 870 acres. Fourteen and four tenths to 17 miles of the system will be on Forest Service land, 0.4 miles on Bureau of Land Management land, and the rest on private or other non-federal lands.

Based upon the revised, more probable levels of mining (see table 1-1a), a considerable portion of the proposed rail network will not be needed. Specifically, the Slug Creek-Dry Valley loop, portions of the Blackfoot Narrows-Diamond Creek spur, and the Rasmussen-Enoch-Long Valley loop, as shown in figure 2-1, will be eliminated. The most practical network would be that shown in figure 3-5 with the Slug Creek and Dry Valley extensions eliminated. This network would reduce the mileage of track by 22.18 miles in Slug Creek and Dry Valley, 8 miles in Rasmussen Valley, and 8 miles in Enoch Valley. It will require 20 miles of new track rather than the 50 to 55 miles originally proposed. The 11.4 mile spur from Montpelier to Bloomington would still be required.

C. ACCESS ROADS

Some companies have recognized the need to accommodate increased traffic volume and loads by widening access roads to proposed mining operations and by surfacing them with gravel or bitumen. Improvement of these roads relates most directly to the actual mining operations but also forms an integral part of the overall mining program.

The Alumet Group plans to widen the Diamond Creek road and the road through the Blackfoot Narrows and surface them with gravel or bitumen. Approximately 12 miles of existing road would be upgraded, of which about 3.5 miles are on lands administered by the BLM or Forest Service and 8.5 miles cross private lands. Approximately 75 acres would be disturbed if the roads were improved sufficiently to accommodate two-way traffic.

IMC proposes to construct a 30-foot-wide access road to the Husky No. 1 mine in Dry Valley, in a common corridor with the proposed extension of the EPCO track from the North Maybe Canyon mine. One proposed route follows the east side of Dry Valley for 3.4 miles to a proposed load-out facility. An alternative route follows the west side of Dry Valley for 5 miles to an alternate load-out facility farther up the valley. Approximately 0.4 miles of the first route and 3.8 miles of the second are on lands administered by the Forest Service; land disturbed by these routes would be 16 acres and 23 acres, respectively. Either road could serve as the primary access route to Lower Dry Valley.

Monsanto Chemical Company plans to improve access roads to the proposed Trail Creek and Caldwell Canyon minesites in conjunction with the mining operations. However, no specific roads are noted in the mine plans. The first 3.5-mile segment of Slug Creek Road, which provides access to the Caldwell Canyon site, would probably be upgraded when mining commences.

The J. R. Simplot Company plans to improve South Sulphur Canyon road to provide suitable access to the Middle Sulphur Canyon minesite. About 40 acres would be disturbed.

There would be no change in locations or acreages for access roads under the revised, more probable level of mining as shown in table 1-1a. All as listed would be required.

D. UTILITIES

Expanded mining operations will necessitate the construction of additional distribution lines to supply the power required at minesites (Map 13). In order to meet the projected power demand, Utah Power and Light, Inc. proposes to construct a 138-KV line from the Caribou Substation near Soda Springs northeastward to the vicinity of Schmid Ridge, the approximate center of future load. From this point, tentatively identified as located in the general area of the northern end of Monsanto's proposed Caldwell Canyon project, 46-KV lines will be constructed to the various mine sites as needed. No specific routes have been identified for this system, but the 138-KV line will follow a direct course into the region and likely cross the Aspen Range near Trail Canyon. Minimum clearing widths will be 110 feet for the 138-KV line and 50 feet for the 46-KV lines.

Lower Valley Power and Light, Inc. will supply the power requirements of Alumet's proposed Diamond Creek and Lanes Creek projects by constructing a 46-KV overhead line, about 30 miles long from Freedom, Wyoming, west through Tincup Canyon and then south through Upper Valley to the projects. It is unlikely that service to additional mining operations could be provided by Lower Valley Power and Light until the long-range expansion plans for construction of additional lines from Freedom to the Goshen Substation south of Idaho Falls have been completed. About 182 acres would be disturbed.

The natural gas pipeline, as described on page 3-10 of the draft statement, will not be needed. Alumet now plans self-calcining of the rock.

E. CURRENT OUTLOOK

Based on comments received during the Draft EIS review period as reflected in the revised rate of production (figure 1-1a), the proposed transportation and utilities systems have been modified to more accurately portray this change.

The revised rate of production will drastically reduce the additional mileage of new railroad needed for ore transport. Although the proposed loop network insures efficient railroad service, this system can not be supported by the reduced level of mining currently projected.

The existing EPCO spur will not be capable of safely and adequately accommodating the increased traffic without expansion. Initially, this expansion would consist of constructing segments of passing track where needed to enable two-way concurrent train movements. Eventually, however, increased mine production will exceed this capability and double-tracking as initially proposed will be required.

There is little likelihood that the EPCO spur will be extended southward into upper Dry Valley because of the limited reserves held by Beker Industries in the area and the unlikelihood of mining operations on the Husky Number 1 lease within the foreseeable future. This, coupled with the Monsanto preference for continuance of truck ore haul, will exclude the entire Slug Creek-Dry Valley loop.

Officials of Alumet have stated that they have now abandoned efforts to secure approval for a railroad route through the Blackfoot Narrows. Based on available data, that portion of Alternatives 3 and 4 depicting a route north through Enoch and Rasmussen Valleys into the Diamond Creek drainage would serve the Alumet operation. The revised routing is shown in figure 3-1-a.

Alumet has begun feasibility studies to determine if other routes can be found that would be more economically efficient and result in less impacts than the proposed route. Specific routes were not available to include in this document.

As a result of these revisions of the proposed railroad system, the area of disturbance would be reduced from approximately 870 acres to 290 acres.

In addition, the Georgetown Canyon natural gas pipeline will not be constructed by Alumet, and the 149-acre disturbance initially proposed will not occur.

CHAPTER II
DESCRIPTION OF THE EXISTING ENVIRONMENT

A. NATURAL ENVIRONMENT

1. CLIMATE

A general description of the climate of the region is given in Part 1.

2. LAND RESOURCES

a. Land Surface

The proposed railroad routes generally follow the gentle gradients of the major valley. The route from Long Valley to the south end of Enoch Valley and into Rasmussen Valley climbs from about 6,300 feet in Long Valley to nearly 6,700 feet at the summit between Enoch and Rasmussen Valleys. The route following the constricted passage through The Narrows of the Blackfoot River from Lower Valley to Rasmussen Valley climbs only about 100 feet, but the climb into Upper Valley along this general route may be significantly steeper, depending on the specific route chosen. The constricted routes from Dry Valley to Slug Creek Valley drop about 100 feet through Dry Canyon, and about 200 feet through Goodheart Canyon.

b. Geology and Mineral Resources

The geology of the area is described in Part 1.

Rock for the railroad roadbed will probably come from local sources, which are abundant and of good quality. Some will be obtained from cuts required to maintain the grade of the roadbed. Materials for roads will also come from local sources. Towers and power lines will come from outside the area.

c. Soils

The proposed transportation and utility systems will disturb about 1,340 acres of land, crossing 13 landtype associations. The landtypes associations are described in detail in Part 1.

At the more probable level of mining, 790 acres will be disturbed.

The transportation corridors will tend to occupy alluvial lowlands, which commonly are wet and marshy. Bearing strengths are very poor, and excavations in these soils cave and slump readily.

3. WATER RESOURCES

a. Water Supply

1. Surface Water

Streamflow characteristics of the area are described in Part 1. The major transportation routes will be concentrated in the Blackfoot River, Slug Creek, Dry Valley Creek, and Diamond Creek valleys and along several lesser streams, gulches, and drainage channels.

Continuous-streamflow data are available only for Blackfoot River, peak-flow data are available near the mouth of Angus Creek; they are in general insufficient for hydrologic design of stream crossings, buffer zones, flood control, fish passage, and many other items.

2. Ground Water

A description of the general ground water conditions along the proposed transportation and utility corridors is given in Part 1.

b. Water Quality

A general description of the water quality along the proposed transportation and utility corridors is given in Part 1.

4. AIR RESOURCES

The air quality along the proposed transportation and utilities corridors ranges from good to very good, inasmuch as the corridors systems are mainly in open, undeveloped areas. The air quality of the region is further described in Part 1.

5. VEGETATION

The proposed transportation and utility corridors will occupy 42 miles of conifer-aspen, 12 miles of mountain brush, 43 miles of sagebrush, and 41 miles of wet meadow and riparian cover types. These cover types are described in Part 1. Forage production ranges from 200 to 3,500 pounds (air dry weight) per acre. Although some timber is present, it has been uneconomical to harvest.

6. WILDLIFE

A description of the wildlife in the area is given in Part 1. Most of the species in the area will be encountered by the proposed transportation and utility corridors. The more important species are discussed here.

Several important elk habitats occur along the proposed transportation systems. An estimated population of 500 elk are believed to inhabit or migrate through the proposed transportation corridors at various times throughout the year. Significant elk calving areas are in the Diamond Creek, Dry Valley and Slug Creek corridor, and wallows have been identified in the Diamond Creek, Dry, and Goodheart Creek valleys. Critical winter range exists along or very near Slug Creek, Diamond Creek, Blackfoot River and Rasmussen Ridge. Elk migration routes and traditional trailways occur in the Blackfoot River corridor, the Rasmussen Valley corridor, the Diamond Creek, Dry Valley, and Slug Creek corridors and the Trail Creek-Johnson Creek corridor.

Two deer populations winter in the northern part of the area. One group migrates south and west from the Wooley Range and other ranges to the Soda Spring Hills to winter. Recently, the Idaho Fish and Game Department counted 672 deer on this winter range. The rest generally migrate west or southwest from the higher elevations of the Aspen and Preuss Ranges to the lower elevations and foothills just above the Bear and Blackfoot Rivers. The Idaho Fish and Game Department counted 1256 deer in this group.

Deer migration routes occur in the Soda Springs area, the Blackfoot River Road area, Rasmussen Valley area, Enoch Valley area, Trail Canyon area, the area between Trail Canyon summit and the Blackfoot River, Johnson Creek area, Goodheart Creek area, Slug Creek area, Dry Valley area, Diamond Creek area, Blackfoot River Narrows and upper Georgetown Canyon area. See map 8.

Winter ranges in Trail Canyon and Georgetown Canyon are proposed corridor routes. Approximately 200 acres of deer winter range will be crossed in Trail Canyon and 700 acres in Georgetown Canyon. Important spring-fall deer use areas will be traversed in Slug Creek, Diamond Creek, Blackfoot River Narrows, and by the Blackfoot River Road.

Summer ranges occur in Dry Valley, Diamond Creek, and Rasmussen and Enoch Valleys.

Moose are scattered throughout the area; cover types along the proposed corridors provide excellent habitat for an estimated 50 moose in Trail Canyon between the summit and the Blackfoot River, Johnson Creek corridor, Slug Creek corridor, Dry Valley corridor, Diamond Creek corridor, Rasmussen Valley and Enoch Valley corridor, Blackfoot River Narrows and upper Georgetown Canyon corridor.

Grouse, partridge, doves, and waterfowl also occur in significant numbers along the proposed corridors. Three sage grouse strutting grounds are known, as well as nesting areas and brood-rearing habitats.

Known sage grouse nesting and brood-rearing areas occur in the corridor between Trail Canyon summit and the Blackfoot River, Slug Creek corridor, Dry Valley and Rasmussen Valley and the Blackfoot River Road corridor.

Two species of forest grouse and blue and ruffed grouse, are common throughout all of the proposed corridors. Major known concentration areas occur within the Trail Canyon, Blackfoot River, Rasmussen Ridge, Diamond Creek, Slug Creek, Dry Valley and Georgetown Canyon corridors.

Remanant populations of sharptail grouse, a "status-undetermined" species, could be present in the 15 mile corridor between Soda Springs and the Blackfoot River Road. Much of this are is in dryland farming for wheat with pockets of brush and trees which would support limited populations of sharptails.

Bald eagles are known to winter in Rasmussen Valley, Slug Creek and Trail Canyon, and are believed to winter in Georgetown Canyon and the Paris-Bloomington-Montpelier area. Two of the highest known densities of sparrow hawks in southeastern Idaho occur from Soda Springs to Blackfoot River Road and Trail Canyon. Important raptor nesting aeries, particularly for golden eagles and prairie falcons, are in the Blackfoot Narrows and Georgetown Canyon areas.

Important nesting and brood-rearing habitat for greater sandhill crane occurs in marshes along Diamond Creek, Slug Creek, Dry Valley, Enoch Valley, Rasmussen Valley and Blackfoot River corridors. Greater sandhill crane habitat is also suitable for the newly-introduced whooping cranes.

Although peregrines are known to nest in six locations in the the extreme southeast corner of Idaho, they have not been specifically identified along the proposed corridors. Optimal habitats, however, do exist in Blackfoot Narrows, Georgetown Canyon, and Trail Canyon.

7. FISHERIES

A description of the fisheries in the region is given in Part 1. Streams near the proposed transportation and utility corridors that support significant populations of fish include the Blackfoot River, Diamond Creek, Slug Creek, and Paris Creek. The Blackfoot River is one of the main fisheries in the area and is a passage for the cutthroat trout spawning run from the Blackfoot River Reservoir.

B. CULTURAL ENVIRONMENT

1. LAND USE

a. Land Ownership

Of the proposed 60 to 66 miles of railroad (depending upon alternative selected), 14.4 to 17 miles will be in the Caribou National Forest, 0.4 miles on lands managed by the Bureau of Land Management, and 6.0 miles on State-owned lands. The remainder will be on privately-owned land, with approximately 35 miles on land currently farmed.

b. Agriculture and Range

Agriculture is practiced in the vicinity of proposed transportation and utility systems in lower Slug Creek, Dry. and Enoch Valley. Crops are grain and hay. Approximately 24 miles of dry farmland and 11 miles of irrigated farmland will be traversed by the proposed corridors.

Almost all vegetative cover types, especially conifer-aspen, mountain brush, sagebrush-grass, wet meadow, and riparian, occur on or near the proposed transportation and utility routes. Forage production ranges from 200 to 3,500 pounds (air dry weight) per acre. Sheep and cattle grazing is the dominant land use. Only part of the vegetation is consumed by livestock and wildlife.

Most of the land is federally owned, with some State lands, and the remainder privately owned. Public lands are generally used for summer grazing; private lands, for spring, summer, and fall grazing. Livestock are both trailed and trucked onto these lands.

Fires are infrequent and have not significantly changed forage species or grazing operations.

2. SOCIOECONOMIC DEVELOPMENT

The proposed transportation and utility corridors will cross mostly farmland and rangeland. No developed lands are involved.

3. TRANSPORTATION SYSTEMS

a. Railroads

Part 1, Chapter II, discusses the railroad network serving southeastern Idaho. This section covers the part of the railroad system that provides exclusive service to some of the existing and proposed phosphate mining operations.

The single-track railroad spur serving the phosphate plants and mining operations leaves the main railroad line about one-half mile east of Soda Springs and proceeds northward past the Monsanto Chemical Company plant two miles north of Soda Springs and the Beker Industries fertilizer plant at Conda. Sidings off the track permit direct product loading from these plants plus the J. R. Simplot beneficiation plant at Conda.

The spur continues northward from Conda and follows the base of the west slopes of the Aspen Range for about seven miles. It then swings eastward, crosses the Blackfoot River and proceeds south along the Blackfoot River drainage for about six miles. The line then crosses the Blackfoot River and ascends the Dry Creek drainage in Dry Valley to the North Maybe Canyon Mine. The spur line is approximately 28 miles long. A rail siding about two miles long swings northward from the spur line to the Wooley Valley mine load-out facility in Wooley Valley.

The railroad spur and sidings are entirely on private land with the exception of a quarter-mile segment of track which crosses land administered by the Bureau of Land Management, approximately one and one-half miles north of Conda. The railroad grade and alignment vary from flat and straight to 2 percent and 10 degrees horizontal curve.

This spur was originally constructed by the El Paso Natural Gas Company in 1966, but has since been acquired by the Union Pacific Railroad, which maintains the line as well as the radio communications and signal systems used for traffic control. Regulations permit only one train at a time on the track.

The J. R. Simplot Company, Stauffer Chemical Company, and Beker Industries use this spur for ore haul. Simplot ships 26-30 covered hopper cars of washed and dried ore concentrate from the Conda beneficiation plant over the Omaha-Portland mainline north to the Simplot fertilizer plant in Pocatello. Haul frequency is one trip per week from May through November and one trip daily from November through May. Twenty-eight cars of raw ore are shipped daily from the Wooley Valley mine south over the Omaha-Portland mainline to the Stauffer Chemical Company fertilizer plant at Leefe, Wyoming. In addition, 67 cars of raw ore are shipped from the mine north over the Omaha-Portland mainline and Pocatello-Butte line to Stauffer's elemental phosphorus plant at Silver Bow, Montana. The operating season extends from June through October. Two trains haul a total of 180 carloads of ore daily from the Maybe Canyon mine to the Beker Industries beneficiation and fertilizer plant at Conda from late June through October.

During the late 1950's, a railroad spur was constructed from the main line at Georgetown, seven miles eastward to the Central Farmers Fertilizer Company processing plant in Georgetown Canyon. Approximately three miles of the spur are on Forest Service lands. Use of this spur ceased when mining and processing ended in 1963, but most of the track remains. Brake overheating problems caused by the excessive sustained grades plagued trains hauling from the plant.

b. Highways and haul roads

A significant component of the phosphate mining operations is road access for equipment, materials, and mining personnel. County and Forest Service roads link Federal and State highways with the access roads to the phosphate mines.

Most county roads were constructed prior to phosphate mining in the area. The roads were originally constructed to serve farms and cattle ranches. Traffic on these roads has progressively increased with the expansion of phosphate mining and recreation use. However, the magnitude of this increase in unknown because a traffic-counting program is not maintained on the system.

The Blackfoot River road is the main access to the Wooley Valley, Maybe Canyon, and Henry mines. This road leaves State Highway 34 about 11.5 miles north of Soda Springs and extends eastward to the phosphate area. The first 3.5-mile segment from the junction with State Highway 34 to the junction with Monsanto Chemical Company's restricted haul road at the inactive Ballard phosphate mine has been surfaced with asphalt pavement and accommodates two-lane traffic. The next 7-mile segment has been widened to two lanes and surfaced with crushed gravel. The Blackfoot River road ties to the Slug Creek road in Lower Valley.

The Slug Creek road runs from Georgetown Canyon north through the Slug Creek drainage, Blackfoot Narrows, and Lanes Creek drainage, and ties to State Highway 34 about 5 miles east of Wayan on the north. The northern 17-mile segment of the road from the junction with State Highway 34, down the Lanes Creek drainage and through the Blackfoot Narrows, serves as the access route for mining personnel living in Wyoming. The road is about 16 feet wide; only short stretches have gravel surfacing.

The Trail Canyon road serves as an alternate primary access road to the area from Soda Springs. It leaves State Highway 34 about 2.5 miles north of Soda Springs, proceeds east through Trail Canyon, then turns south and descends into the Trail Creek drainage, linking with the Blackfoot River Road in Lower Valley. The road is about 13 miles long; the first six miles are two lane and asphalt paved; and the remaining seven miles, 12-20 feet wide, with gravel surfacing. Winter snow-removal operations cease at the end of the pavement section, and use of the road for mining access is restricted to late spring, summer, and fall. Steep grades, narrow road widths, and lower maintenance standards limit use of the road to primarily access only. Service traffic transporting equipment and materials favors the Blackfoot River Road.

Expanded mining operations will use the Slug Creek road in Slug Creek, Dry Valley Road, and Georgetown Canyon road in Diamond Creek, resulting in increased use and vehicular loads. These are single-lane or narrow two-lane roads with little or no gravel surfacing.

The two-lane gravel-surfaced Bloomington Canyon Road provides access to the proposed Paris-Bloomington mine. The road leaves U.S. 89 at Bloomington and proceeds west about 1.25 miles to the minesite. Traffic volumes are light, but traffic counts are not maintained to document the amount of daily activity on the road. Agricultural and recreational traffic make up the bulk of the traffic volume.

The Monsanto Corporation hauls phosphate rock over its privately owned, 22-mile haul road from the Henry mine to the company's elemental phosphorus plant near Soda Springs. This 40- to 80-foot wide road was originally constructed in 1959 to serve the Ballard mine, and in the late 1960's it was extended north to the Henry minesite. The road is surfaced with an 18-inch asphalt mat, and adverse grades are infrequent to facilitate efficient ore haul. Haulage trucks attain speeds of fifty miles per hour, which enables them to climb the few adverse grades along the route with minimum additional fuel consumption. The road crosses public highways at four locations; all are guarded by traffic-actuated semaphores. Use of the road is restricted to company ore trucks limited administrative traffic. Four truck units, each consisting of a diesel tractor and three tandem belly-dump trailers haul ore from the mine to the plant from about mid-May until November. Each truck unit operates for two eight- or nine-hour shifts per day, five days per week.

c. Utilities

Adequate power is available for current mining operations. A 46-KV overhead power line from the Conda area supplies electricity to the ongoing activities. This line runs northward for about 5 miles to Monsanto's proposed Blackfoot Bridge mine.

The line then splits; one line continues northeast for about 6 miles through the inactive Ballard mine and terminates at the Henry mine.

The other 46-KV line veers southeastward, across the northern end of the Aspen Range and follows the Blackfoot River, and branches Lower Valley. One branch extends northward for about 5 miles across the Blackfoot River to the Wooley Valley mine. Net power demand at this site is minimal. The other branch continues about 4.5 miles southeastward from Lower Valley across the northern end of Schmid Ridge into Dry Valley to the North Maybe Canyon mine.

A 138-KV line extending eastward from the inactive plant in Georgetown Canyon has been inactive since 1963.

These distribution lines are shown on Map 13.

4. RECREATION RESOURCES

The outdoor recreation aspects of the areas involved in the proposed transportation and utility corridors are described in Part 1.

5. ARCHEOLOGIC AND HISTORIC VALUES

There has been no systematic study of the proposed transportation and utility route. Available data, as described in Part 1, indicate a strong possibility of other unidentified archeologic sites scattered along the proposed transportation and utility routes discussed in this Part. There are no registered historic sites along the proposed corridors, nor are there any under consideration or proposed.

6. AESTHETICS

The aesthetic characteristics of the area and its classification are given in Part 1. Georgetown Canyon is classed as distinctive, but other areas along the proposed transportation and utility corridors are classed as low to moderate.

CHAPTER III
ENVIRONMENTAL IMPACTS

A. NATURAL ENVIRONMENT

1. LAND RESOURCES

a. Land Surface

Impacts of the railroad are the roadbed and the cuts and fills required for minimum roadbed grades. Few cuts are needed in the main valleys; more are necessary where the routes pass through constricted terrain between valleys, such as the areas between Long, Enoch, and Rasmussen Valleys; the region of the Blackfoot Narrows, which connects Lower Valley with Rasmussen and Upper Valleys; and Dry and Goodheart Canyons, which connect Dry and Slug Creek Valleys. Parts of each route will require large cuts and fills. Some additional grading will be required to improve access roads.

The rail network to serve the lower more probable level of mining would impact only Long, Enoch, Rasmussen and Upper Valleys.

b. Geology and Mineral Resources

About 160,000 cubic yards of rock will be used to construct the railroad roadbed, but it will represent an insignificant depletion of the resources available in the region. Impacts from improvement of access roads and construction of utilities will be minimal.

About 50,000 cubic yards of rock would be required for roadbed for the rail network to serve the lower more probable level of mining.

c. Soils

About 1,340 acres of soils within the rights-of-way will be disturbed. About 600 acres will be covered by roads, ballast and track, and other surfaces. Construction will compact soil and increase erosion by removing of vegetation. Although a significant acreage is involved, the overall impact on the area is moderate because of the long distances over which the impact is spread.

The rail network to serve the lower more probable level of mining would disturb 290 acres of soil, access roads about 138 acres, and utilities 182 acres for the Freedom-Tincup Canyon power line.

2. WATER RESOURCES

a. Water Supply

1. Surface Water

Construction of bridges, culverts, and other drainage structures will temporarily alter natural drainage channels. Major drainages affected are the Blackfoot River and Angus, Diamond, Georgetown, and

Slug Creeks. At some locations, streams will be realigned, altering channel characteristics. Full impacts cannot be determined until detailed engineering designs of the structures and exact locations are available.

At the lower, more probable level of mining, impacts will be mainly to Diamond and Angus Creeks. The improvement of the road through the Blackfoot Narrows will affect the Blackfoot River primarily during its construction.

2. Ground Water

Impacts on ground water from the proposed transportation and utility corridors will be minimal at either level of mining. Some perched water tables will be drained by cuts, and recharge to some ground-water systems will be reduced to a minor degree by paved and compacted areas.

b. Water Quality

Erosion from 1,340 acres disturbed during construction will add sediment to nearby streams. Runoff from transportation facilities may contain trace elements, petrochemicals, organic matter, and sediment. Their impacts on water quality are unknown, but will probably be high but local in the short term. Slurry transport of ore may make certain trace elements and nutrients available to solution (see Part 10.2).

At the lower, more probable level of mining, impacts will be generated from about 790 acres.

3. AIR RESOURCES

At either level of mining, fugitive dust and particulates during construction will cause local but only slight deterioration of air quality, as will increased emissions and dust from unpaved roads as a result of increased traffic.

4. VEGETATION

About 1,340 acres of vegetation will be removed or disturbed during construction, resulting in a loss of 500 to 1,500 tons of forage. Fires will increase significantly along the proposed rail route and in areas made more accessible by new or improved roads.

The areas occupied by the track and ballast or by roadway will be removed from vegetative production. The shrubs and trees along the rail route will be sprayed or burned. The remainder of the right-of-way will revegetate to some form of herbaceous succession.

At the lower, more probable level of mining, about 790 acres will be removed or disturbed, with a similar proportional reduction in forage loss.

5. WILDLIFE

The proposed transportation and utility corridors will directly reduce wildlife habitat along their entire lengths; off-site impacts will be even more significant. Depending on locations of the corridors, large mammals such as deer, elk, bear, some fur bearers, and raptors and others will abandon or only occasionally use areas that will be heavily used. This abandonment will vary from a few yards to a mile from the road or railroad. The following estimated number of wildlife species will be directly affected through habitat loss because of railroad and roads:

Habitat Type	Mammals	Birds	Reptiles	Amphibians
Dry Land Farms	23	49	2	2
Irrigated Farms	37	125	7	4
Riparion	35	173	6	4
Sagebrush-Grass	42	65	14	6
Mountain Brush	55	101	12	5
Conifer-Aspen	54	107	10	5

The migration and general movement of elk will be affected along the Blackfoot River, Diamond, Johnson, Slug, and Trail Creeks, and Dry and Rasmussen Valleys. An estimated 500 elk are believed to use these areas. Calving grounds in Dry Valley will be unsuitable and will be abandoned. A major elk wallow utilized in breeding season will be lost.

On the assumption that half the deer that winter in the Soda Springs area migrate from the area, about 1,600 deer will be affected by blockage of migration routes by the transportation corridors. These deer will probably seek new winter ranges that are now near carrying capacity. A loss of 350 deer could be expected.

Increase in road access and use, increase in hunter availability, road kills, loss of winter range for 30 deer in Trail Canyon and 300 to 400 deer in Georgetown Canyon will greatly reduce wintering deer numbers, according to the Idaho Fish and Game Department. The loss of important spring-fall and critical summer ranges will displace deer from these ranges to other areas probably near carrying capacity. This will overtax habitat in areas not directly impacted by the transportation corridors. Herds could be reduced by as many as 1,000 deer. The impact is further emphasized when an average annual recruitment of approximately 675 fawns will not be brought into the population annually. The figure of 675 fawns was computed from the average buck/doe and fawn/doe ratios for the area compiled by the Idaho Fish and Game Department.

The Diamond Creek corridor is expected to alter a traditional wintering area for 5 to 10 moose. The corridor will affect about 40 miles of riparian habitat and displace about 30 moose that migrate through the area.

Winter use of the railroads will impact moose who are likely to use these snow-free areas as travel routes.

The proposed transportation corridors in Slug Creek, Dry Valley and Rassmussen Valley will result in partial or complete abandonment of three known sage grouse strutting grounds and four known nesting areas. The increased improvement in access will result in heavier hunting pressure for sage grouse; over-hunting could become an important limiting factor. An estimated 500 acres of suitable breeding, nesting and brood-rearing habitat for forest grouse will be removed. This could result in an estimated annual loss of approximately 250 birds through reduced carrying capacity.

The proposed transportation system in the Diamond Creek, Blackfoot River, and Slug Creek areas could disrupt the nesting, brood-rearing, and feeding of Canada geese. A 1975 survey found 100 nesting pairs of Canada geese within these corridors. Increased activity around the nesting sites could significantly reduce this population.

Three known bald eagle wintering areas and two possible wintering areas could be rendered unsuitable and abandoned. As adjacent suitable habitats are probably at carrying capacity, the result will be further reduction of the wintering population.

Two important nesting aeries for golden eagles and prairie falcons will be adversely impacted, but the degree of impact cannot be predicted. Some aeries may be abandoned due to human disturbance or loss of prey species near the nesting sites.

Important nesting and brood rearing habitat of the greater sandhill crane will be impacted in the Diamond Creek, Slug Creek, Dry Valley, Enoch Valley, Rasmussen Valley and Blackfoot River drainages. According to the U. S. Fish and Wildlife Service, there were 500 nesting pairs in the areas in 1975. The cranes are unlikely to adjust to the transportation impacts.

Two endangered species may be impacted by the proposed transportation routes. The recently introduced whooping crane could use the same habitat now occupied by the greater sandhill cranes. Important nesting and brood-rearing habitat is in Diamond and Slug Creeks, Dry, Enoch, and Rasmussen Valleys, and Blackfoot Corridors. Reducing habitat by construction of railroads and all-weather road systems may prevent the continued spread of whooping cranes. The human disturbances permitted by these corridors will cause some birds to abandon the valleys.

Peregrine falcons will be affected by disturbance to their nesting and feeding areas. The impacts on the riparian habitats in Trail Canyon, Blackfoot Narrows and Georgetown Canyon could result in abandonment of any existing peregrine falcon nests in or adjacent to these areas through reduction of prey species. Normal migration routes may be disrupted.

The proposed transportation routes will preclude further reintroduction of whooping cranes in six localities.

At the lower, more probable level of mining, impacts from construction and use of new transportation facilities would be limited to Enoch and Rasmussen Valleys. With the elimination of the routes in Slug Creek and Dry Valley, there would be no impacts from transportation facilities themselves in these areas.

6. FISHERIES

Increased sediment load and changes in channel configuration can reduce the productivity of the stream ecosystem.

Construction of the proposed transportation system in the Paris-Bloomington-Montpelier area will degrade the streams.

The Monsanto corridor between Soda Springs and Blackfoot River has a railroad and haul road and will only add airborne particulate matter to the aquatic habitat.

If the proposed railroad or improved road through the Blackfoot Narrows encroaches on the Blackfoot River, the fishery in and below the the Narrows will be seriously degraded and cutthroat trout spawning runs will be restricted and possibly blocked.

Lesser impacts, largely from sediment during construction, will occur on Angus, Diamond, Georgetown, and Paris Creeks, and the Blackfoot River.

At the lesser, more probable level of mining, impacts will be limited to Angus and Diamond Creek from the railroad, and to the Blackfoot River from improving the Blackfoot Narrows-Diamond Creek access road.

B. CULTURAL ENVIRONMENT

1. LAND USE

a. Land Ownership

A strip of land 60 to 100 feet wide and about 25 miles long will be converted from farmland to railroad right-of-way. This impact is discussed more fully in the following section.

At the lesser, more probable level of mining, about 15 miles of right-of-way will be affected.

b. Agriculture and Range

The major impact on agriculture will be the loss of about 200 acres of farmland and up to 1,300 acres of rangeland used for rights-of-way for the transportation system. Associated with this is the disruption of traditional farming and grazing patterns. Grazing allotments will be divided, pastures subdivided, water sources isolated, and livestock trailing and movement restricted.

About 270 acres of range are on federal lands leased for grazing. Based on an average of 400 pounds of forage per acre, 103 AUM's of grazing valued at $610 annually, will be lost. At current grazing fees, this amounts to $122.

Favorable impacts could be realized if the railroads were used for shipment of livestock and crops. This, however, is not likely inasmuch as the rail network will probably move ore only.

At the lesser, more probable level of mining, about 200 acres of farmland and 590 acres of rangeland will be affected.

2. SOCIOECONOMIC

There are no significant direct impacts on the socioeconomics of the area. The cumulative impacts of the proposed development of the phosphate resources are described in Part 1.

3. TRANSPORTATION AND UTILITY SYSTEMS

The primary impact on the transportation system will be the increase in traffic volumes. Most present roads will not be able to adequately accommodate the anticipated increase in traffic volume. (Some of the mining companies have recognized this deficiency and included access road improvements in their proposed mining plans.)

Approximately 1,470 employees of the various mining operations and processing plants presently drive to and from work each day. About 260 of these people commute to the minesites northeast of Soda Springs. At the projected rate of proposed development, employee numbers would be 3,340 and 1,480 respectively by 1985. This is almost a six-fold increase in the number of people using the mine access roads. In addition, there would be an equal or greater increase in the volume of supply and service traffic to the area. Projected increases in county populations will also contribute additional traffic flows to the network. The growth rate for Caribou County is estimated at 18.4 percent per year. The number of vehicles in the county will likely increase proportionally.

The roads that will be most affected are the Blackfoot River Road from State Highway 34 through the Blackfoot Narrows, the roads in Diamond Creek, Dry Valley, Rasmussen Valley, the three mile segment of the road in Slug Creek south of its junction with the Blackfoot River, the Trail Canyon road, and the first two miles of the Bloomington Canyon Road.

Increased traffic will result in accelerated deterioration of road surfaces, increased noise, a reduction in air quality, an increase in the number of traffic accidents, and an increase in road maintenance costs. Available data are insufficient to quantify the magnitude of these effects, but they are likely to be moderate and long-term.

According to the Idaho Transportation Department, Federal-aid, State highway and local highway funding levels are not adequate to meet the present rate of deterioration of the transportation system much less the accelerated deterioration caused by expanded phosphate development.

Because of this limited funding, any improvements or reconstruction related to increased traffic or heavy loads would place an additional burden on the already underfinanced state and local road system. In addition, funding for highway maintenance is not adequate to meet existing demands.

The proposed road improvements will improve the access into the area, reduce travel time and vehicle operation and maintenance costs, reduce the potential for traffic accidents, and improve driving comfort and convenience.

The impacts on the railroad and power systems serving the proposed mines are also discussed in Part 1, since these systems are extensions of the regional systems.

4. RECREATION RESOURCES

The proposed transportation and utility corridors at either level of mining will degrade somewhat the outdoor recreation in parts of the area. Rail and utility lines will lower the aesthetic appeal and diminish the sense of remoteness. Although new and improved access roads will make parts of the area more accessible, increased usage of these areas for outdoor recreation will diminish the quality of the experience.

5. ARCHEOLOGIC AND HISTORIC VALUES

Impacts cannot be determined or assessed at this time because it is not known whether archeologic sites exist along the proposed right-of-way. No known historic sites will be affected by the transportation and utility corridors as now proposed at either level of mining.

6. AESTHETIC VALUES

The proposed transportation and utility systems will have a substantial impact on the aesthetic values in the area. The degrees of impact for various segments are shown in table 3-1. They have been developed on the basis of a procedure in which ratings of high, moderate, and low for each of three variables are combined to determine the level of impact, as shown in the following table:

VISUAL CONTRAST

	Sensitivity Level - Visual Variety								
	H_h	H_m	H_l	M_h	M_m	M_l	L_h	L_m	L_l
High	*	*	*	*	*	*	*	*	*
Moderate	*	*	*	*	-	-	-	-	0
Low	-	-	-	-	0	0	0	0	0

EXPLANATION
* - High Impact
- - Moderate Impact
0 - Low Impact

↙- Sensitivity Level
H_m
↖- Visual Variety

Table 3-1--Transportation and utility impacts on aesthetic values. H=high; M=moderate; L=low

Landscape modification proposed	Critical viewer position	Sensitivity level	Visual Variety	Visual contrast of modification	Degree of impact for each modification
Railroad, service road, and powerline--Rasmussen-Enoch-Long Valley loop	Road along Blackfoot River	H	L	M	H
Do.	Road in Enoch Valley	M	M	H	H
Railroad, service road, and powerline--Slug Creek-Dry Valley loop	Road along Blackfoot River	H	M	M	H
Do.	Road along Slug Creek	M	M	M	M
Railroad, service road, and powerline--Slug Creek East alternative	Road along Slug Creek	M	M	M	M
Railroad, service road, and powerline--Goodheart Canyon alternative	Road along Slug Creek	M	M	M	M
Railroad, service road, and powerline--Blackfoot Narrows-Diamond Creek spur	Road along Blackfoot River	H	H	H+	H+
Railroad, service road, and powerline--Paris-Bloomington spur	U.S. 89	H	M	L	L
Railroad, service road, and powerline--Upper Dry Valley spur and connecting track	Road in Dry Valley	L	M	M	M
Powerline and service road (1st alternative)--Maybe Canyon mine to Diamond Creek mine	Road along Diamond Creek	H	M	H	H

Table 3-1.--Transportation and utility impacts on aesthetic values--Continued

Landscape modification proposed	Critical viewer position	Sensitivity level	Visual Variety	Visual contrast of modification	Degree of impact for each modification
Powerline and service road--Afton to Diamond Creek mine	Road along Diamond Creek	H	M	H	H
Do.	Road in Smokey Canyon	L	M	H	H
Do.	Road along Tygee Creek	M	M	H	H
Do.	County roads in Star Valley	M	M	M	M
Do.	U.S. 89 near Afton	H	L	H	H
Gas pipeline and service road	Road in Georgetown Canyon	L	H	H	H
Do.	Road along Diamond Creek	H	M	H	H
Access road--Blackfoot Narrows to Diamond Creek mine	Blackfoot Narrows	H	H	H+	H+
Do.	Road along Diamond Creek	H	M	M	H
Access road--south Dry Valley	Road in Dry Valley	L	M	M	M
Upgrade--road along Slug Creek	Road along Blackfoot River	H	M	M	H
Do.	Road along Slug Creek	M	M	M	M
Upgrade--road in Sulfur Canyon	U.S. 30	H	L	L	L
Do.	Road in Sulfur Canyon	L	M	M	M

CHAPTER IV
MITIGATING MEASURES

State and Federal laws, regulations, and administrative policies that require mitigation or reclamation of mining impacts, and requirements of the surface-management agencies and the USGS District Mining Supervisor are discussed in detail in Part 1.

All public roads for access will conform to applicable State, county, and local standards. Railroads, communication systems, signs, and signals will conform to standards and requirement of the Union Pacific Railroad and State and Federal regulatory agencies.

No specific mitigating measures are required for land surface or for geology and mineral resources, inasmuch as impacts are minimal.

Impacts to soils will be minimized by enforcing protective stipulations on rights-of-way and other permits granted by Federal agencies.

Retaining structures could be built to contain cut and fill materials and thereby lessen the extent of the disturbance.

Transportation crossings and all construction work below the mean high waterline will come within the purview of the Idaho Stream Channel Protection Act, which provides for fish passage and for designs and construction methods that minimize pollution and provide for permanence and stability of channel-related structures.

Insofar as possible, rights-of-way should be at least several hundred feet from stream channels to minimize delivery of sediment to streams. Bare soils should be mulched and seeded and provisions made to trap sediment onsite.

The reduction in recharge to the ground-water reservoir caused by transportation systems could be mitigated somewhat by alining the systems to avoid recharge areas. For example, if there is a choice between a route over a permeable gravelly alluvium or a shale, the route over shale should be selected. Wherever possible, routes should be planned to avoid stream courses where recharge may take place. Cuts likely to intercept ground-water bodies should be minimized wherever practicable, and fills should not be placed in streams or other possible areas of recharge if alternative alinement is possible.

Fugitive dust resulting from construction activities should be controlled or reduced by sprinkling.

Alteration of vegetation off rights-of-way from flooding or drainage should be minimized by constructing sufficient drainage structures of adequate capacity to approximate natural drainage.

Constant monitoring and pre-evaluation of all uses will detect and lessen unknown impacts and provide the basis for early correction.

No bridge sites or railroad crossings should enter below any high water mark. Transportation systems where feasible should be set back from any water course. If there is encroachment of streams, lakes, and reservoirs, reclamation or compensation should be determined and approved. Continued maintenance or proper removal after use should be assured to prevent aquatic stress through deterioration.

Measures to mitigate impacts on wildlife are detailed in Part 1.

There are no mitigating measures for changes in land ownership other than fair compensation for lands utilized for rights-of-way.

There are no mitigating measures for the conversion of farmland and range to rights-of-way. Disruption of traditional livestock movements can be mitigated by providing adequate crossings. Alternative livestock watering facilities should be provided to compensate for those isolated by the proposed transportation and utility systems. Rights-of-way should be fenced where possible to prevent accidental injury to livestock; gates should be provided to allow supervised crossing and trailings. Boundaries of Federal grazing allotments should be adjusted to eliminate small isolated parcels created by the rights-of-way.

No specific mitigating measures are required for the socioeconomic impacts of the proposed transportation and utility systems.

The improvements proposed for the roads partially mitigate adverse impacts on the road system. County and Forest Service road maintenance programs will also mitigate adverse impacts to some degree.

The impact of transportation systems could be further mitigated by instituting staggered work shifts at the minesites and beneficiation plants or by creating mass transit systems for mining and processing-plant employees.

The mitigating measures for impacts on outdoor recreation discussed in Part 1 apply in general to the impacts of the transportation and utility systems.

Mitigating measures should include a program of archeologic test excavation in advance of construction and the stipulation that archeologic evidence or artifacts uncovered during construction be reported immediately and that further work in the vicinity be postponed until the find is evaluated by a competent archeologist. Archeologic clearances will be required on all lands where Federal actions are involved.

Measures to mitigate the impacts of the transportation and utility systems on the aesthetics are detailed in Part 1.

CHAPTER V
ADVERSE EFFECTS THAT CANNOT BE AVOIDED

Cuts and fills required to maintain grade, especially along the rail routes, will unavoidably alter the land surface. Mineral resources will be depleted. About 160,000 cubic yards of rock (50,000 of the lower mining level) will be used for ballast for the proposed rail lines. Soil productivity will be lost on approximately 600 acres of the rights-of-way. Erosion and sediment increases during the construction period are unavoidable, especially during periods of high wind or intense rain. Some drainage channels will be altered during construction, resulting in depleted soil moisture and increased sedimentation Soil compaction and topsoil disturbance from off-site construction activities cannot be avoided. If mitigating measures are instituted, the off-site impact will be limited to the construction period and a recovery period of about two years.

More impermeable and unvegetated surfaces will be created, resulting in more overland flows, increased sediment, and deterioration of quality of surface water.

Reaches of streams will probably have to be altered and relocated for bridges, culverts, and embankments. Impacts cannot be quantified until detailed engineering designs of structures are available and exact site locations are known. The impacts will be dispersed and will occur mainly during construction.

The roads, railroads, pipelines, and parking lots will unavoidably reduce ground-water recharge. Cuts in hillsides for roads and railroads will drain some perched ground-water bodies. This will remove soil moisture in some places that now support vegetation. Minor amounts of water used for compaction of road foundations and dust control will be lost to other uses.

Even with mitigating measures, increased sediment is unavoidable during construction near streams.

Air quality will deteriorate near the transportation routes; the impact is local and minor.

Vegetation will be removed from about 1,340 acres (790 acres of the lower mining rate) used for roads, railroads, and utility systems.

The number of fires will increase along the railroad right-of-way and in formerly remote areas.

About 1,000 acres of habitat will be altered, and wildlife will be unavoidably disrupted or lost. The migrations of elk and deer will be unavoidably distrupted near the Blackfoot River, Diamond, Johnson, Slug, and Trail Creeks, and Dry and Rasmussen Valleys. If totally blocked, they could not be restored. Year-round habitats of moose will be disrupted in the Diamond Creek area, and a wintering site for about 10 moose will be removed. Elk calving areas and wallows in Dry Valley will also be lost. As many as 250 elk and 1,250 deer will unavoidably be displaced.

Destruction of 3 known strutting grounds and 4 known nesting areas of sage grouse in Dry, Rasmussen, and Slug Creek Valleys is unavoidable. About 500 acres of habitat for forest grouse will be removed.

The proposed transportation system in the Blackfoot River, Diamond Creek, and Slug Creek areas will unavoidably disrupt the nesting, brood-rearing and feeding habitats of Canada geese and other waterfowl.

The proposed transportation corridors will reduce feeding habitats of peregrine falcons in the area.

At the lesser level of mining, impacts from the transportation system will be reduced in the Slug Creek-Dry Valley area by the elimination of the proposed railroad.

Transportation and utility systems will impact fisheries by altering stream banks and channels and thus increasing sediment rates and water temperature. In areas of major disturbance such as the Angus Creek, Blackfoot Narrows, Georgetown Creek, and Stewart Creek, fish populations may be eliminated or seriously reduced.

The conversion of about 200 acres of farmland and 1,300 acres of rangeland (590 acres at the lower level of mining) to right-of-way cannot be avoided.

Traditional grazing patterns will be disrupted. Realignment of boundaries of some grazing allotments may be necessary to eliminate uneconomic isolated parcels.

Unavoidable adverse effects of increased traffic on the road system include increases in the number of traffic accidents, in the cost and frequency of road maintenance, and in the conflict between mining and non-mining traffic. Temporary delays and poor travel conditions are unavoidable during reconstruction of the roads proposed for improvement. These impacts will be minor and occur only over a short time period.

Much of the undeveloped character of the area will be altered by the transportation systems. Recreational uses will shift from those involving a natural environment and a moderate-to-high level of outdoor survival skills to those types of recreation of a more social nature and more tolerant of an environment with man-made intrusions.

Inadvertent destruction of any previously unidentified archeologic site during construction is an adverse effect that cannot be avoided.

Visual impacts that detract from the aesthetic setting of the area cannot be avoided. Large cuts and fills will contrast markedly with the surrounding environment.

CHAPTER VI
SHORT-TERM USE VERSUS LONG-TERM PRODUCTIVITY OF THE AREA

The transportation and utility systems discussed in this Part are proposed to supply the needs of mining and processing phosphate rock to the year 2000, as set forth in the 16 mining plans filed with the Conservation Division, U.S.G.S. The development and construction of these facilities will affect both the short-term and long-term productivity of the area by temporarily disturbing some 1,340 acres and by more permanently removing some 600 acres.

In the short term, construction over about a two-year period will disturb about 1,340 acres. Forage losses are estimated at 511 AUM's, currently valued at $3,000 annually. Increased sedimentation in streams as a result of the construction will reduce the productivity of the fisheries. Wildlife will be permanently displaced to other areas, resulting in population reduction.

In the long term, about 1,300 acres of farm and rangeland will be taken out of production. The loss of 200 acres of grain and pasture crops will be permanent. Soil compaction and topsoil disturbance will reduce the productivity of the 740 acres temporarily disturbed during construction of as much as 50 percent.

Estimated loss of 1000 acres of wildlife habitat will affect the long-term productivity of wildlife in the area. Deer, moose, and elk will be displaced to other habitats already at or near carrying capacities. The long-term result will be a reduction in game herds in the area.

Aesthetic quality and outdoor recreation resources will also experience long-term impacts. Access road improvements will open now-remote areas to increased use, and the aesthetic impacts of railroads and utility lines will further reduce the quality of the recreation experience.

At the lower, more probable level of mining, the impacts will be reduced as stated in Chapter V.

CHAPTER VII
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The major commitment of resources for the proposed transportation and utility systems is the materials required for constructing the railroad. Amounts will depend on the route selected; about 160,000 cubic yards of rock will be used for ballast, about 225,000 railroad ties, and about 4,500 tons of rails. At the lower, more probable level of mining, about one-third of these amounts will be required. From a practical viewpoint, this commitment is irretrievable. An unknown amount of natural resources required for construction of roads and utility lines will also be irretrievable.

Inadvertent destruction of archeologic sites during construction will be an irreversible loss.

CHAPTER VIII
ALTERNATIVES

Various agencies and authorities are continually analyzing each component of the transportation and utilities systems of the area to determine where improvements, expansions, and additions are necessary to meet current and future demands.

Discussed here are those general utility and transportation corridors, and those routes and methods of transportation suggested by the mining companies, the utility companies, and the Union Pacific Railroad as possible means of meeting the transportation and utility requirements of the proposed increase in development of the phosphate resources in southeastern Idaho.

The majority of the mining plans indicate railroads as the preferred mode of transporting the ore from the mine to the processing plant. For this reason and because a railroad system could be designed, built, and operated as a single-system common carrier capable of serving all of the proposed mines without the costly duplication and/or paralleling of facilities, rail transport was selected by the Task Force as the assumed means of transportation. For those mines that can be serviced by extension of an existing proprietary truck-haul road without further duplication of facilities, truck-haul is considered the primary mode of transport. Slurry pipeline, truck, and belt conveyor were indicated in the mining plans as alternate means of transport and are also considered.

Alternative transportation corridors consist primarily of either variations in the proposed transportation corridor configuration or degree or extent of development. Wholly new alternative transportation corridors, while possible, are not likely because of constraints imposed by drainage patterns or topography, operational limitations inherent in a particular mode of transportation, or the presence of all or portions of a developed transportation system in a corridor which makes total abandonment economically undesirable or environmentally untenable.

There are four alternatives to the proposed railroad system.

Alternative 1 (fig. 3-2) is the same as the proposed railroad network, except that the last 10.3 miles of the Rasmussen-Enoch-Long Valley loop would be eliminated. This would result in additional traffic on the upper end of the EPCO line and through the Blackfoot Narrows and complicate train scheduling procedures. Elimination of 10.3 miles of track would reduce the amount of environmental impact attributed to transportation.

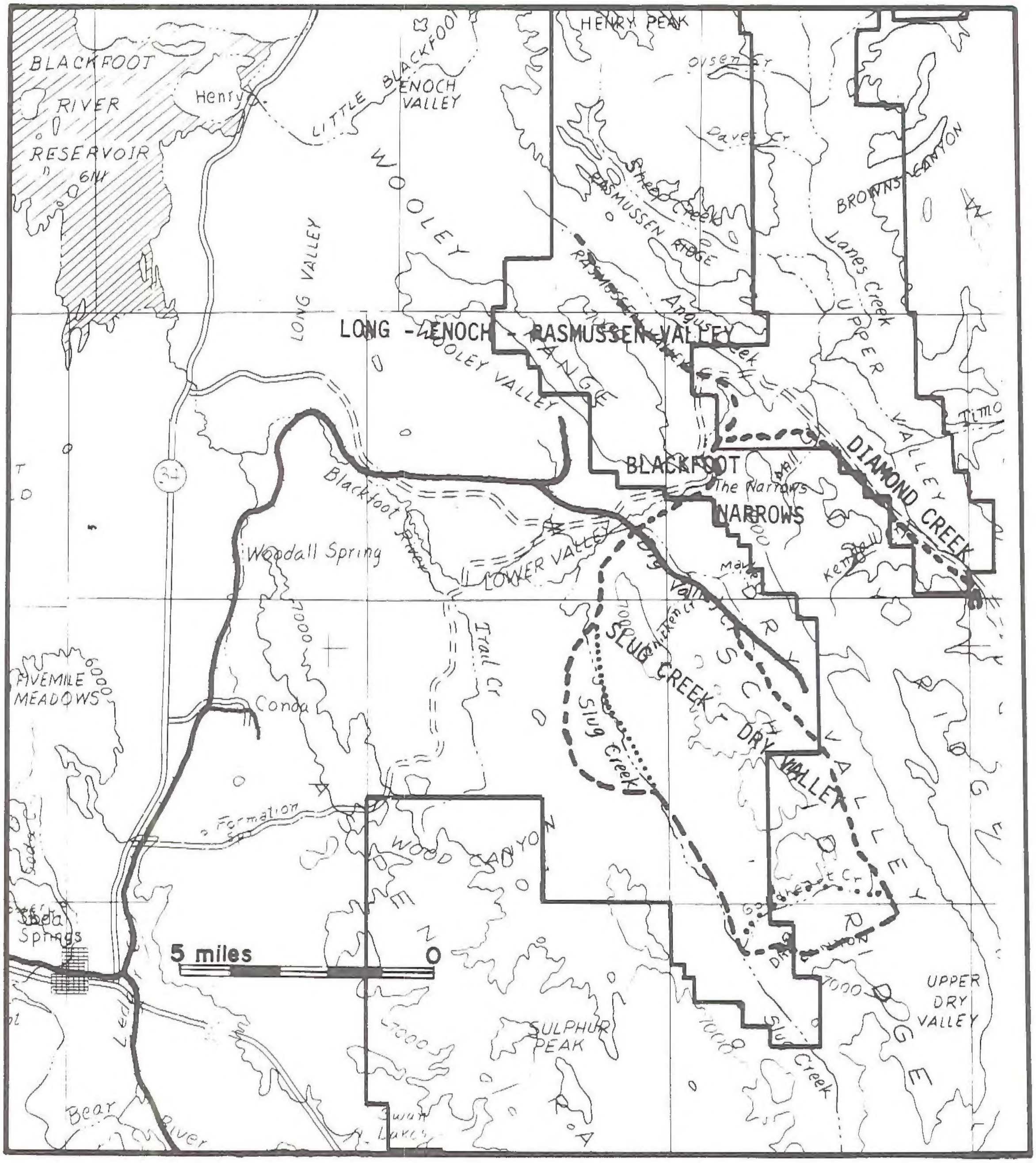
Alternative 2 (fig. 3-3) would minimize the amount of new railroad to be constructed by eliminating the last 10.3 miles of the Rasmussen-Enoch-Long Valley loop as in Alternative 1, and in addition, the Slug Creek and Dry Valley segments through the elimination of the proposed Dry or Goodheart Canyon interconnection. These changes would result in approximately 19 fewer miles of railroad and the environmental impacts attributed to the system would be reduced accordingly. Rail haulage on this system would require an additional traffic scheduling integration and control to minimize delay and conflicts between train movements on the various components of the system.

Alternative 3 (fig. 3-4) is the same at the proposed railroad network, except that the route through the Blackfoot Narrows would be eliminated. The Rasmussen-Enoch-Long Valley loop would continue south to the Diamond Creek project instead of west to the Blackfoot Narrows. Approximately six fewer miles of railroad would be needed and environmental impacts resulting from railroad construction through the Narrows would be eliminated.

Alternative 4 (fig. 3-5) would eliminate the route through the Blackfoot Narrows as did Alternative 3, but in addition the Dry or Goodheart Canyon portion of the proposed Slug Creek-Dry Valley loop would also be eliminated. The Slug Creek and Dry Valley segments of the loop would dead-end as they did in Alternative 2. These modifications would reduce the length of the railroad network by approximately 16 miles, and environmental impacts would be lessened accordingly.

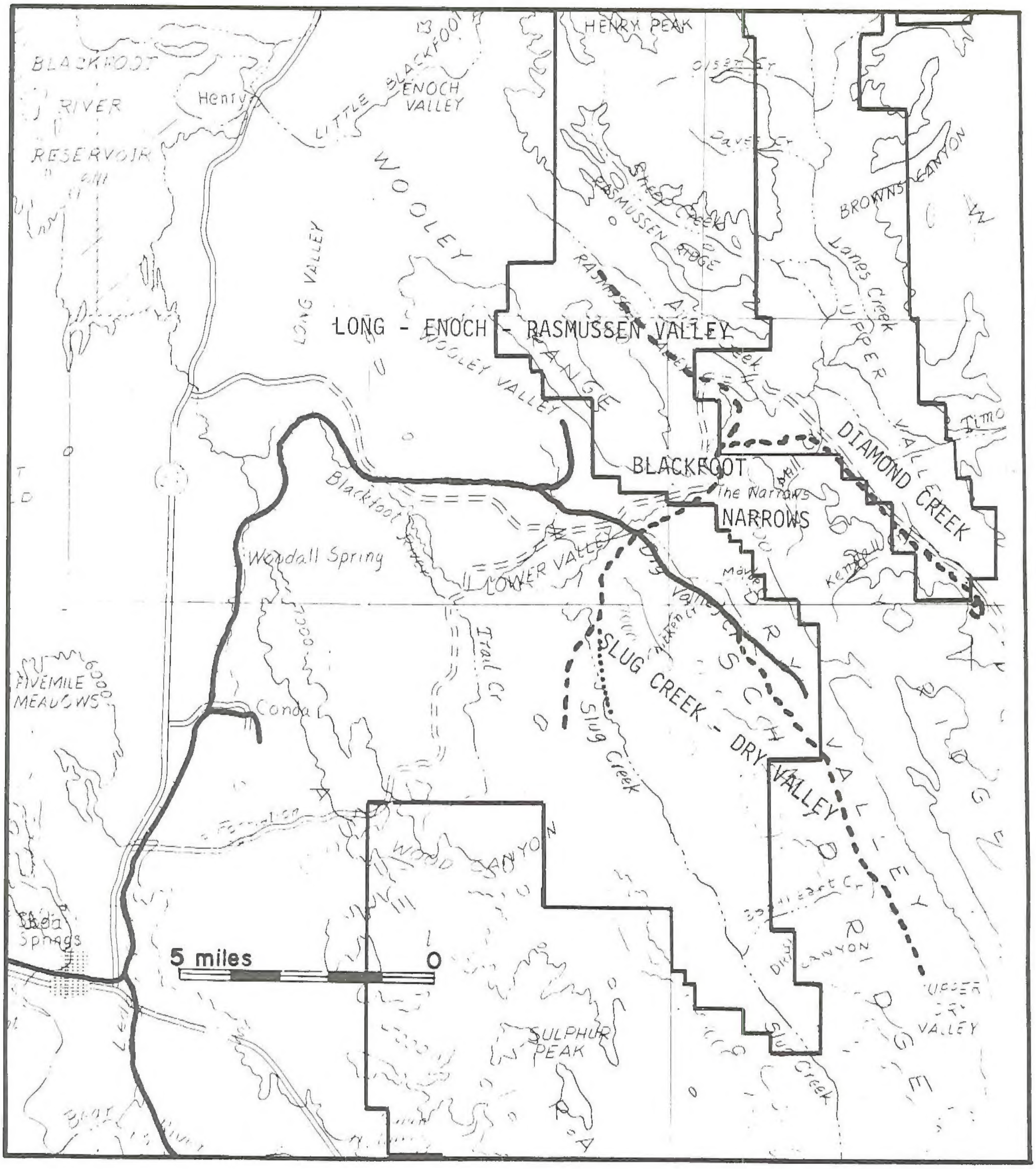
Alternatives to the proposed improvements of the access and service road network are limited to variations in the degree or extent of the system involved. Since roads exist in every drainage where mining operations have been proposed, totally new routes are not warranted.

Various mining companies have proposed to selectively improve segments of the road system which provide access to their mining operations. An alternative to this would be a joint effort on the part of industry, State and County government, and the Federal government to establish a coordinated road network, upgraded to the necessary level and maintained at sufficient intervals to satisfy the needs of all users of the system. A primary concern in establishing transportation development levels involves upgrading of the routes to minimize accident frequency. Implementation of this alternative would assure equitable cost sharing, establish priorities for route improvement programs, and clarify the responsibilities of each party. A joint comprehensive transportation planning effort would be of primary importance in implementing this alternative. The transportation plan should show present and anticipated traffic volumes and composition on the system and a schedule of capital improvements necessary to accommodate future traffic generated by all users of the system. In addition, the planning effort should include an analysis of financial responsibilities to be incurred by the various government entities and the private sector. The feasibility of making adjustments in both State and Federal phosphate royalty allocations should be investigated so that the counties accruing the environmental and socioeconomic impacts of phosphate mining and processing would receive a more equitable distribution of funds. An objective of this alternative could be to widen and pave the Blackfoot River Road through the Blackfoot Narrows and north to State Highway 34, widen and pave the Trail Canyon Road, and widen and gravel or pave the roads in Diamond Creek, Rasmussen Valley, Dry Valley and Slug Creek.



Existing RR ——— Proposed Alternate RR - - - - - - - Subalternate RR·········

Figure 3-2.--Railroad network Alternative 1.



Existing RR ——— Proposed Alternate RR - - - - - - - Subalternate RR ....

Figure 3-3.--Railroad network Alternative 2.

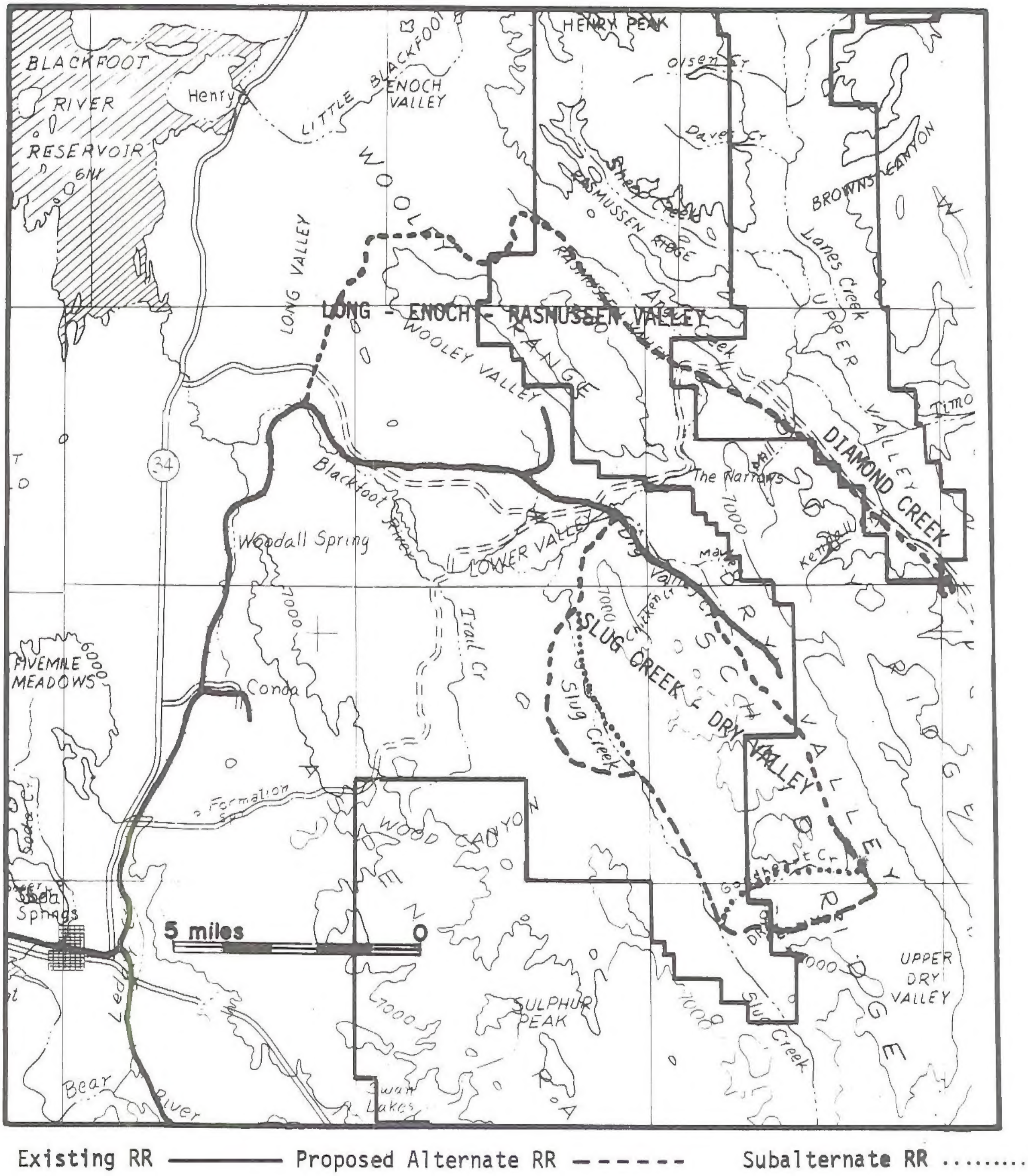
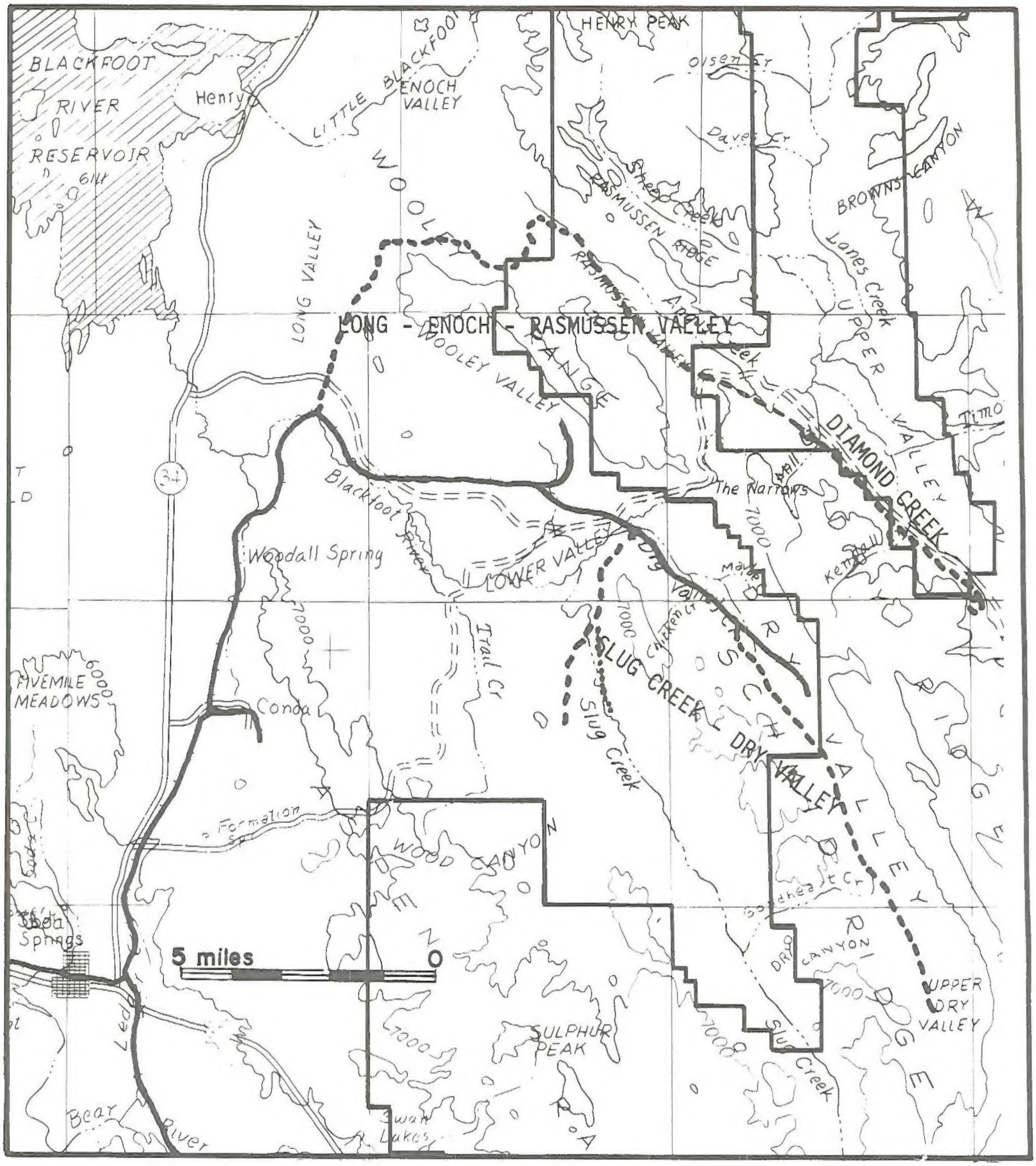


Figure 3-4.--Railroad network Alternative 3.



Existing RR ——— Proposed Alternate RR - - - - - - Subalternate RR ....

Figure 3-5.--Railroad network Alternative 4.

In contrast to the above, another alternative to that proposed would be to minimize access and service road improvements based on a desire to limit environmental impacts. The Blackfoot River Road and Trail Canyon Road would be retained in their present condition and improvements on the roads in Diamond Creek, Rasmussen Valley and Slug Creek would be confined to that needed to supply bare access needs. This alternative would be the minimum road system development possible and yet enable mining operations to proceed. Consequences of this alternative would be user delays, traffic conflicts, increased accidents and increased user costs for fuel and vehicular repair.

Both Utah Power and Light, Inc. and Lower Valley Power and Light, Inc. analyzed alternatives to their proposed power routes. Utah Power and Light considered extending the 138 KV line in Georgetown Canyon northward to the load center on Schmid Ridge, forming a loop with the proposed route from the Caribou Substation near Soda Springs. Construction difficulties and the determination that a loop system was not needed made this route impractical.

An alternative to the Tincup Canyon route proposed by Lower Valley Power and Light, Inc. would originate near Afton, Wyoming and proceed west through Smoky Canyon to the Diamond Creek drainage, then turn northward to the project. The corridor through Tincup Canyon was selected over this alternative because the Freedom Substation is a stronger delivery point and a route originating from this substation integrates into the Company's long range expansion plans.

Slurry pipeline should be considered as a primary mode of ore transportation for any mine or group of mines where access is difficult or where other modes of transport would have an unacceptable impact upon the environment.

In slurry pipelines, mineral solids in a finely-divided state are suspended in a fluid (usually water) and pumped to the destination. Solids content of the slurry is usually 50 percent to 60 percent by weight, but slurries of up to 70 percent solids have been pumped. There are no limitations on length. Pipelines may be laid on the surface to facilitate repairs and maintenance or buried to protect against freezing, vandalism and accidental damage and minimize environmental impact. Each pipeline must be individually designed, usually on the basis of extensive test data.

Environmental impacts of a slurry pipeline can only be assessed from complete design data, including routing, topography, whether buried or surface, location of pumping stations, power requirements, power routing, and route and specifications for any necessary access road.

The truck transport of phosphate rock required special equipment. The large earth moving machines used in the mines are not efficient on hauls beyond a couple miles in length. The highway legal dump truck is not adequate in size to handle the large tonnage. The mine-to-plant truck transport currently used consists of a tractor with two or more large gondola type trailers. It is highly efficient because of its high speed, high ratio of pay load to horsepower, and high productivity for labor (ton miles per man hour). These trucks require roads of extremely high subgrade and paving standards. Curve and grade specifications are similar to those for a mainline railroad. Such roads are, therefore, privately owned and restricted to the ore-hauling function. High capital cost, right-of-way acquisition problems, and single-company operation factors will probably limit its use in this area. The advantage over rail haul is complete control of ore flow from mine to plant. Capital investment in ore-handling facilities at both mine and plant is generally less than for rail.

Belt conveyors have been indicated as an alternate mode of transportation in several of the mining plans.

A belt conveyor has several advantages over a rail haul system. As a continuous-flow system, it requires minimal loading and unloading facilities and lesser stockpiling facilities. A conveyor system is of necessity a proprietory system giving the company complete control of ore flow from the mine. Conveyors can be used on grades up to 18 degrees (33 percent slope) and can be operated either upgrade or downgrade. Conversely, a belt conveyor capable of moving 500 tons per hour costs two to three times that of a first class railroad. A service road paralleling a conveyor is an operating convenience, but almost a necessity in construction. Electric power service is required at each drive station. Belt conveyors cannot be designed as a common carrier system collecting ore from more than one mine for delivery to more than one plant.

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